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modern plastics

JULY 1941

VOLUME 18 [illegible]MBER 11

AUGUST

Vital insulation through the use of cold molded plastics has been developed by Consolidated Edison Co. of New York for cable limiters. These are used to prevent cable faults from spreading on networks, thus interfering with service. E. M. Beach, of Garfield Mfg. Co., has prepared an interesting article describing the application of plastics in this short-circuit protection for our August issue.

What's in a vacuum? The properties of plastics are put to advantage in numerous new electric vacuum sweepers. C. G. Taylor, of Westinghouse Electric & Mfg. Co. discusses important uses of phenolics in the design of two new cleaners recently put on the market by his company.

• GENERAL INTEREST

• TECHNICAL SECTION

• NEWS AND FEATURES

Cover colors this month PINKCLAY and DEFENSE BLUE (*Created by Textile Color Card Assn.*)

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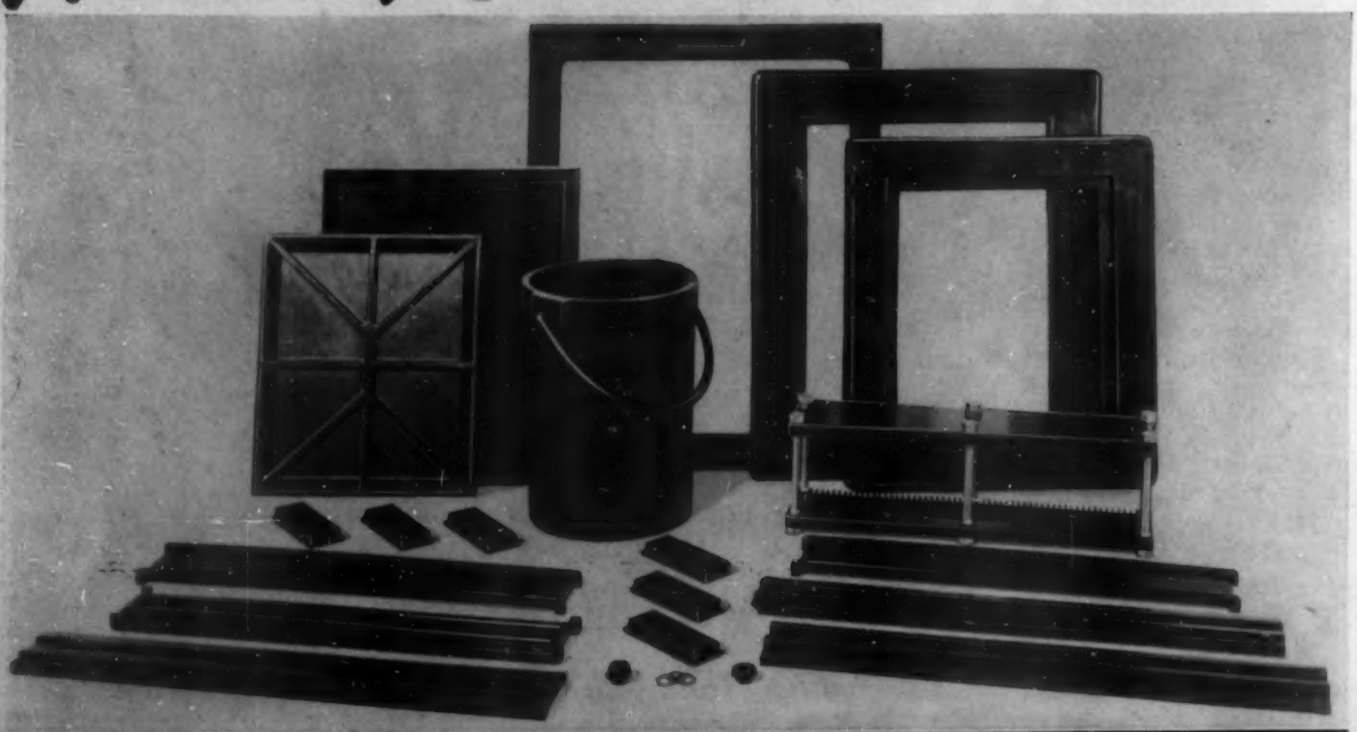

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MODERN PLASTICS
WILLIAM T. CRUSE, Editor

JULY 1941 VOLUME 18 NUMBER 11

Continuous extrusion advances

by PERRY C. GOODSPEED*

NATIONAL defense has given impetus to the dry extrusion of thermoplastic materials as a substitute for metals to such an extent that, although only the baby of the plastics industry, it has had to assume full stature within a year of its birth.

This "wunderkind" was forced to rapid growth because the material lends itself to the replacement of decorative and structural shapes heretofore made of aluminum, stainless steel and other metals vital to the defense program.

The continuous length extrusion of thermoplastic materials has been familiar manufacturing technique to the plastic industry for decades. Nitrocellulose has been extruded for many years on both hydraulic and screw type machines. Cellulose nitrate tubes and rods processed in this manner have been and are extensively used by the fountain pen trade. Rods and odd shaped profile lengths are fabricated into buttons and ornamental jewelry by the novelty manufacturers. In extruding nitrocellulose all manufacturers were obliged to employ the wet or solvent process owing to the nature of the material. This necessitated a time consuming seasoning or curing period generally handled under controlled conditions to insure a stable product. The commercial arrival of other plastics with their respective advantageous properties led to their being extruded. As a result new outlets have been found for some of these materials.

Certain vinyl copolymers have found an important place as electric wire insulation.[1] They have also caught the fancy of the stylist's eye. Shoes, suspenders, hats and other wearing apparel have also been created from extruded vinyl plastics.

Extruded vinylidene chloride has been woven into seat covering for subways where it is doing a superior job. Fishermen have found the small diameter filaments satisfactory for leaders. With the widespread adoption of acrylic resin rods for fabrication by the ornamental jewelry trade one manufacturer has developed a method for extruding this class of plastic.

The dry extrusion of cellulose granules or molding powder was initially developed through the impetus of an automotive demand. The extruded forms cut to length and fastened to metal were used for decorative trim in automobile interiors. The all-out big scale development of extruding plastics came with the inaugu-

* R. D. Werner Co., Inc.
[1] Synthetic Wire Coverings, Modern Plastics, Feb. 1941, page 34.

1

Continuous dry extrusion of thermoplastic materials has made conspicuous progress within a comparatively short period. The material is heated and rapidly forced in a steady stream from a die, set in a screw type extruding machine, much as toothpaste is squeezed from a tube. It is carried down a conveyor and then coiled or cut to length. No other finishing or processing is necessary. Round, flat and fancy shaped rods of varying thicknesses for furniture, lamps, drapery edging, wall trim can be produced. At right the operator is inspecting the extruded molding as it comes from the machine with a caliper to check on accuracy of dimensions. The molding is closely supervised and checked several times

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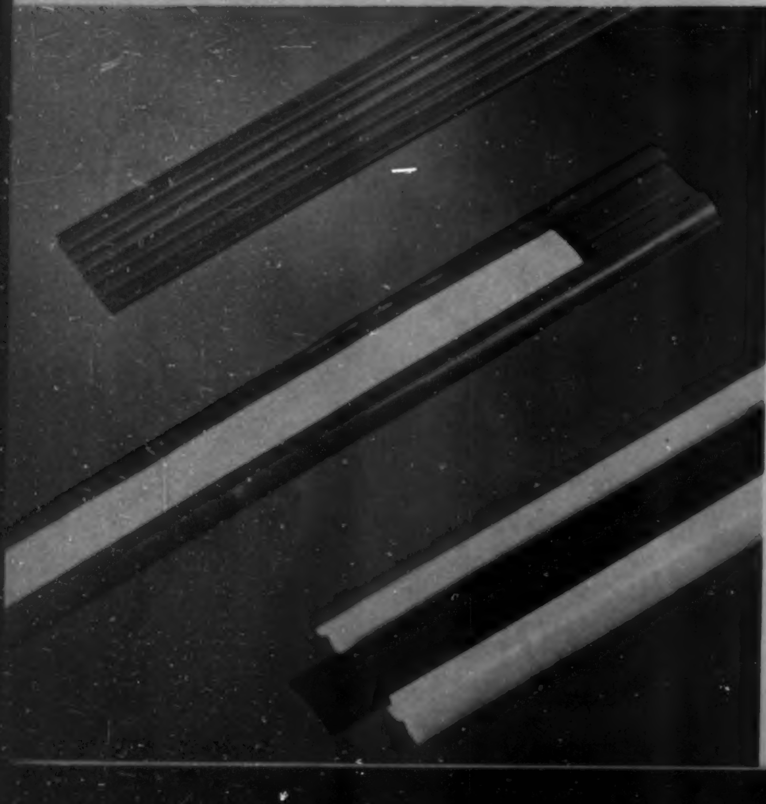

ration of the National Defense effort when various metals became short, leaving the door open for new materials to replace those on priority lists.

Despite this happy situation, the unnatural growth has been a tax on the raw material and machinery manufacturers and, above all, the extruders of plastics themselves. Material manufacturers have had not only to develop special formulations, but also increase their manufacturing facilities. Likewise, manufacturers of extruding machines have had to redesign old equipment to incorporate new ideas and step up production at an almost impossible rate. Extruders of plastics have had to master many manufacturing techniques, learn how to build proper dies and train men as supervisors and machine operators—and all in a comparatively short period of time!

It is interesting to note how necessity has had its hand in perfection of dry extrusion of thermoplastic materials. Within the last 18 months, the industry has made phenomenal strides and overcome difficulties and problems which took compression and injection molding years to accomplish. Although, the process is far from perfect, without question, the outstanding ad-

2—End view of a section of an extrusion plant showing operators cutting off lengths of wall moldings as they come from the conveyor. **3**—Extruded cellulose acetate trim replaces aluminum and other metals for a decorative, washable, edging. **4–5**—Typical moldings used for wall panel joints and cabinet trims are shown, along with an end view of each section. One is a channeled molding with a strip of contrasting colors which slides into place to cover the nails. Table edging has a "biting" strip set at right angles with teeth that grip the wood base and prevent shifting. **6**—Cross sectional diagrams showing profiles of extruded sections

vance in the fabrication of thermoplastics during the past year is continuous extrusion. Heretofore, production in this line has been confined to a few standard sizes of rods and tubes made by the plastic manufacturers themselves, usually from paste (composition containing solvent). Today, with new screw-type extruding being produced by several manufacturers, fairly intricate shapes can be made on a commercial basis and methods are constantly improved in order to make larger and more complicated shapes.

In continuous extrusion of thermoplastics, material is heated and forced through orifices of a die as toothpaste is squeezed from a tube. Because the material hardens simply by cooling, the molding is produced rapidly and can be immediately coiled or cut to length. Since the material is in a finished form, there is no need for further processing or shaping.

Any discussion of the extrusion of thermoplastic materials must necessarily include the following points: materials, equipment and construction of dies.

There are a number of materials available for dry extrusion. Each has one or more specific qualities which can be considered by the prospective user in selecting a material best suited for his individual requirements. A partial list includes: Copolymer of vinyl chloride and vinyl acetate, methyl methacrylate, ethylcellulose, cellulose acetate butyrate, cellulose acetate and polystyrene.

Equipment

One of the important advantages of using screw-type extruding machines is that it permits continuous operation. Reloading or charging which interrupts the production is unnecessary. Machines of the screw type consists of a horizontal cylinder containing a screw and a feed hopper at one end with a die supporting head at the other. Die head, cylinder sections and frequently the screw are provided with independent heat control. Circulating oil is generally used for heating the cylinders while electric heating is used for the screw and dies. There are variations in this arrangement. Some machines are constructed with a die block which is heated by circulating oil.

A variable speed motor for actuating the screw is desirable as large sections containing a volume of material cannot be successfully extruded at the same screw rpm as small sections. Most extrusion installations have an endless conveyor belt take-off, which at the same time, serves for cooling. These belt conveyors also have a variable belt drive in order that speeds may be synchronized with the extruder. Where forced cooling is required air ducts with blow arms spaced about every 6 ft. are used over the moving belt for the purpose. In some cases water is employed for removing the heat. Specialized equipment has been developed for handling certain materials such as acrylic resins where elongated extrusion nozzles have been incorporated as a part of the machines. These nozzles are equipped with heating and cooling controls to allow for wide, varying ranges in temperature. Nozzles are necessarily much longer than the standard units.

A cut-off device is placed at the end of the continuous take-off belt. This serves to cut the extruded material to any desired length. Where small flexible strips or small sections are run, they are wound on rolls or spools.

As in injection molding, where some materials require drying before molding, it is desirable in extrusion to treat highly hydroscopic (*Please turn to page 88*)

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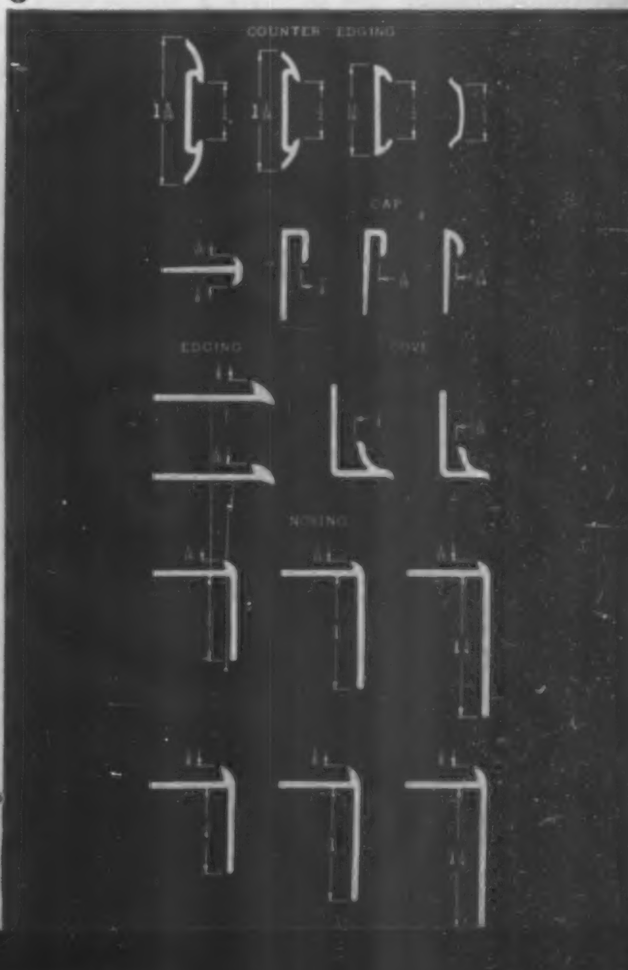

Some examples of art objects with their accompanying rubber mold produced from methyl methacrylate granules mixed with liquid chemical weld. The mold, in each case, is extremely thin and flexible and allows production of items with difficult undercuts. The strange looking head in the lower left hand corner is translucent and carries color. Note the intricate design of the rose and how perfectly details are reproduced by this technique

Art objects in rubber molds

ANOTHER answer to the question "How can I mold plastics at home?" is found in a molding technique that employs thin rubber molds and granules of methyl methacrylate. It is a quick-setting process that turns out a resultant hard material resembling rock salt. According to the ingredients used and the manner in which they are mixed, the artistic creations can have a porous or a smooth surface.

When granules of methyl methacrylate are subjected to heat and pressure, the familiar transparent plastic results. When these granules are mixed with a certain liquid chemical weld and poured into a rubber mold, the outcome is quite different. Instead of a clear material, we find that the result is translucent. The setting in this type of casting is comparatively quick, requiring about 15 to 30 minutes depending on weather conditions and room temperature.

Liquid latex is used for the molds which can be built over shapes made of plaster-of-Paris or other materials. The mold can be as thick as desired, although a great thickness is not necessary. Various types of objects can be made by this method, for example, buttons, novelty jewelry, figurines, bookends, ashtrays and decorative accessories. The object can be removed from the mold after the setting has taken place, although complete evaporation of the weld takes several hours. At this stage, the plastic is in a rubbery state, which permits retouching. After a short time, the material becomes extremely hard. When nothing is added to the methyl methacrylate granules except the weld, the result is a plastic remarkably like marble in color and texture. The addition of an acetate base enamel gives color. When this enamel is mixed with the granules, with the weld added last, the final result is a porous effect. Mixing the granules, then the weld, finally the enamel gives a smooth finish. It is claimed that all shades can be produced, including the subtlest pastels. If so desired, a high luster can be attained by polishing so that the surface is smooth and gleaming. It is said that the material is so durable that nails can be driven into it without cracking. Objects made of this type of plastic will dissolve only under 190 deg. F. or over. Since inexpensive molds can be used and retouching is possible, individuality in design can be obtained.

Credits: Lucite-derived material supplied by Comet Envelope & Paper Co., Incorporated.

Melamine and its derivatives

by WILLIAM H. MACHALE*

IT has been frequently stated that there appears to be a new plastic introduced to the market every year. This statement has been somewhat correct of late, but it may lead to an incorrect impression, and some loose thinking regarding these materials. The development or evolution of a new compound may extend back into chemical history over one hundred years, and be closely related to other compounds which have had an earlier date of introduction. No plastic is an overnight development, and although it is introduced as new, may be tried and tested, altered and modified, under controlled conditions long before it actually appears commercially on the market.

Melamine

The compound melamine, a development of the American Cyanamid Co., is probably one of the most recent additions to the chemical world. Perhaps we should term it a revival, since Liebig in 1834 produced this same material, consisting of only carbon, nitrogen and hydrogen, and called it melamine. Nothing more was done with it at that time. Much had to happen in the evolution of chemistry before this material could

* Plastics Division, American Cyanamid Co.

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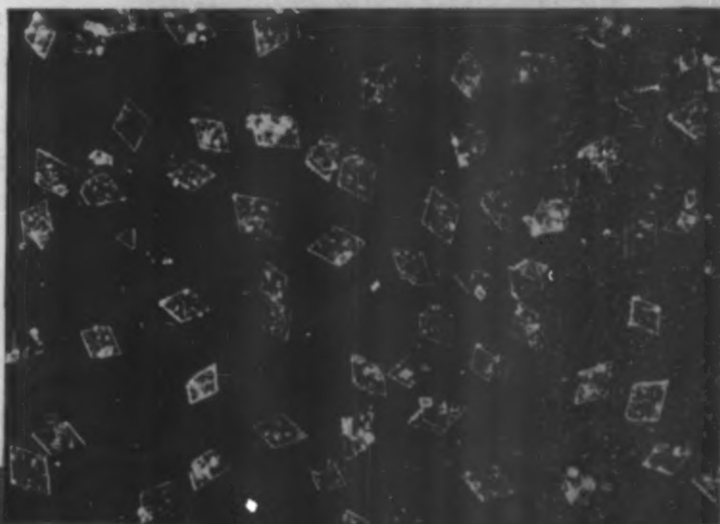

1—In a pilot plant melamine resin was made on a small manufacturing scale while experimental work was carried on under controlled conditions. 2—Melamine crystals photomicrographed 15 x. by reflected light. 3—Preparation of melamine molding compound in the pilot plant for small production runs. 4—To test the use of this material for surface coatings, panels were automatically sprayed with melamine enamel and then baked under infrared drying lamps

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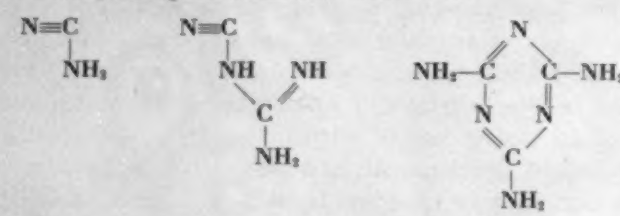
find uses and be available in sufficient quantity at a reasonable price for widespread industrial applications.

The material melamine bears a close relation to the company's basic compound calcium cyanamide, and it was found that melamine could be economically produced from calcium cyanamide by the initial production of dicyandiamide. Melamine may be considered as the trime of cyanamide CH_2N_2, of which dicyandiamide is the dimer. These relationships may be shown by the commonly accepted structural formulas:



Cyanamide Dicyandiamide Melamine

The resulting material, melamine, is only slightly soluble in water, 0.5 percent at 25 deg. C., and melts at the high temperature of 354 deg. C.

Melamine-formaldehyde resins

For the past dozen years there has been a great interest in amino plastics. Urea resins are used for molding compounds, laminating syrups, baking enamels, plywood bonds, cold setting cements, wet strength papers, textile applications, etc. It was only natural, on discovering the high heat resistance and low water solubility of melamine, that an attempt be made to develop this amino compound as a resin.

Through the combination of melamine with formaldehyde, a colorless thermosetting resin was developed which is marketed under the trade mark "Melmac."[1] This resin reacted to heat and pressure in the same manner as urea resins, and became, after polymerization, a hard, infusible, insoluble mass.

Just what could be done with this material? It was certainly more inert than the other amino resins, more heat-resistant and harder. It appeared that it could be combined with an alpha cellulose filler and coloring agents to form a molding compound, could be used as a laminating resin, a baking enamel, a cement, and so on.

A pilot plant was erected at the American Cyanamid Co. laboratories in Stamford, Conn. Samples were produced for small test runs under controlled conditions, closely simulating prospective large scale production and large scale molding and laminating (Figs. 1–4).

In the molding material form—that is, combined with alpha cellulose pulp—it was found that a compound was produced similar in (*Please turn to page 92*)

[1] Trade mark of American Cyanamid Company applied to synthetic resins of its manufacture containing melamine.

5—Molded melamine-formaldehyde resin is molded into lightweight, washable non-shattering tableware for use on the airlines. **6**—Melamine resins with alkyd resin plasticizers are formulated into high-gloss, heat-resistant baking enamels for stove parts and electrical appliances. **7**—Similar coatings are used for outdoor all-weather signs

Shaven and shorn

Molded plastic parts give additional strength to clippers and shearers which make for clean, contented cows, sheep and goats

THESE clippers and shears literally "mow ya down" if you happen to be a cow, sheep, goat—or mule. They are speedy, well designed, easy to use and employ plastics for perfect insulation, durability and good appearance. The ever-increasing spread of power lines makes electrical equipment a necessity on the farm. Among power driven tools are these flexible shaft shears and clippers housed in plastics. They are light, strong, smooth and permanently finished because plastics have been incorporated wherever practical.

Four of the five parts for the Clipmaster and Shearmaster are molded of canvas-base impact material. The other part, a brush screw with brass insert, is molded of ordinary walnut phenolic. The largest impact part is the motor case which is molded in a 2-cavity mold, each cavity made up of 2 split sections which are removable from the yoke by hand. Cut-out sections for the brushes are molded into the part by means of pins bolted into the side of the cavity. A 3-section preform is used to eliminate the bulk factor of the impact material in molding this motor case.

The bearing support which forms the butt-end of the case is molded in an ordinary up and down mold. The "on" and "off" lettering on either side of the opening is indented and later on these letters are wiped in with white paint. Tolerances for this bearing support as it fits into the motor are so close that the protrusion is molded slightly over-size so that it may be machined to give the proper fit. The switch knob is also molded of impact material and fits into the opening on the butt-end of the bearing support. When these three pieces have been assembled, a motor case cover is attached to the end of the bearing support. The motor case cover is molded in a split-cavity mold to form the notches which provide a non-slip grip for the electric cord.

The same plastic unit is used for both tools as illustrated below. The five plastic parts are at the right.

Credits: Bakelite phenolic molded by Chicago Molded Products Corp., for Chicago Flexible Shaft Company.

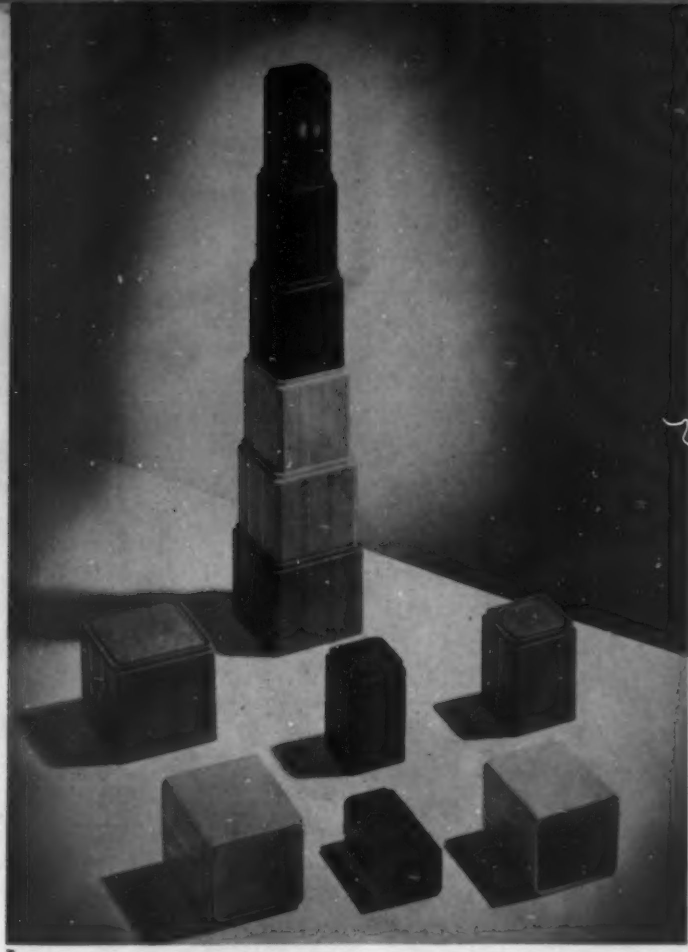
Super juice extractor

ABOUT eleven months ago, when the idea that shortage of non-ferrous metals might exist was ridiculed as a remote possibility, a manufacturer of kitchen appliances put its designers to work on a plastic fruit juice extractor. Plastics were wanted for their sales ability, color and immunity to fruit juices. Now, the company finds it has anticipated any restrictions on strategic materials and reports that although manufacturing costs have increased, this factor is offset by the fact that aluminum is practically unobtainable and, also the permanence and inherent qualities of the plastic.

Completely plastic, the unit is molded of polystyrene and acrylic in vivid colors—red, green, yellow with a shiny black strainer and handle to contrast with a white bowl, arm and reamer. Practically unbreakable, the material is chemically inert, odorless, tasteless, sanitary and acid-resisting. Injection molded for high production, the new juicer compares in price to the die cast and spun metal predecessor. It was shaped to include all the bearings, etc.

In redesigning the old model, the following bad features had to be overcome: oxidation, discoloration of the metal, monotonous color and unattractive shape of the all-metal piece. The principles of operation were so well established that little could be done with the mechanical functions, particularly since the juicer was to fit the standard wall bracket used for mounting other appliances made by the same company. The new model is extremely simple, consisting of a partial sphere cut in the center, the lower half of which forms the bowl and the remaining portion the strainer. The spout instead of having a "hung-on" appearance was made to flow gracefully from the bowl itself to a V-point which provides good pouring facilities. The knob of the handle follows the contour of the bowl and has a cover cemented over the assembly screw to further improve its appearance. (*Please turn to page 96*)

1—Redesigned for smarter looks, efficiency, greater capacity—and more vitamins, a brightly colored all-plastic juicer commands sales attention. The entire unit can be lifted off for easy pouring. Made of three injection molded acid-resisting polystyrene and acrylic parts, it replaces an aluminum model (2) that was both unattractive and subject to discoloration



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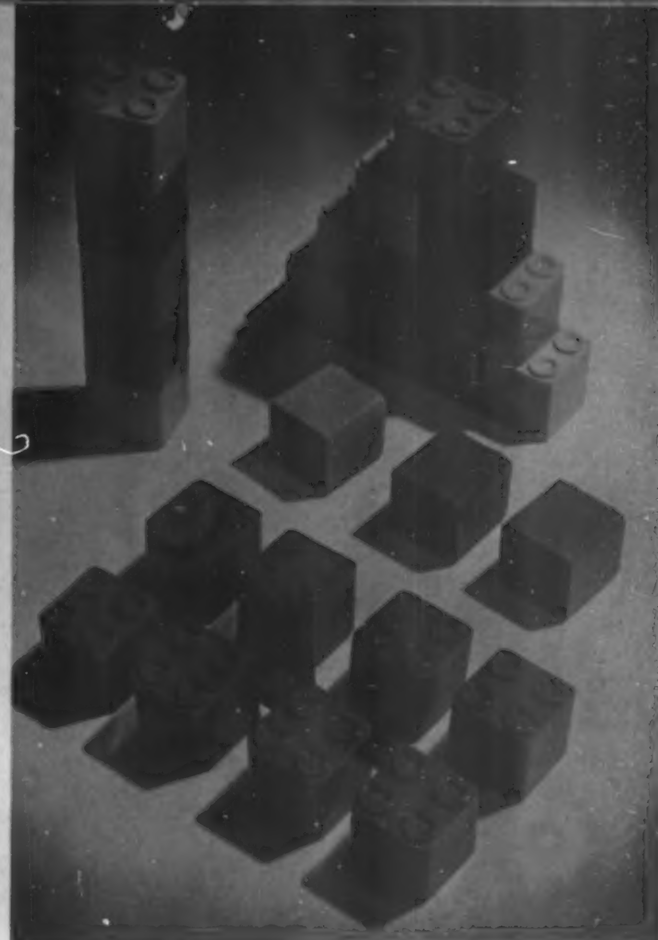

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1—Safe, sane play for youngsters—cellulose acetate blocks that pile and interlock in various sizes and gay colors; tasteless, odorless and sanitary. Embossed barnyard animals molded in on the surface add to the fun. 2—In foreground are blocks just as they come from mold. Background, interlocking building cubes for tower and pyramid

Playing up a market

Eye appeal, improved mass production methods, and hygienic advantages recommend plastics for quality toys and games

GOVERNMENT priorities may affect production of playthings sooner or later, but the theme of "toys as usual" for as long a period as possible still prevails throughout the toy industry.

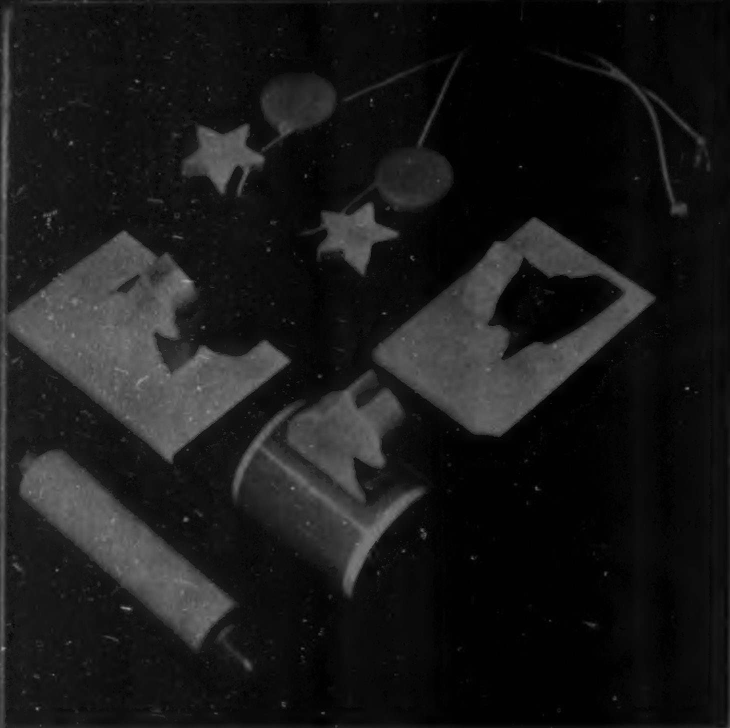
Optimistic plans stress the idea that playthings preserve Young America's way of life. In fact, only 2 percent of 100,000 toys recently displayed at the annual Toy Fair reflected national defense activity. Of course color schemes are largely patriotic, and army and navy toys—soldiers, model airplanes, tanks and equipment—are some indication of the trend of the times.

No exception to the general squeeze on non-ferrous metals, the industry showed more plastic and partly plastic toys than it ever had before. Emphasis on the use of plastics was not stressed as a possible last resort, since most producers indicated they had covered their raw materials to a "reasonable extent," but rather because of their inherent qualities. The wide color range, smooth, permanently finished surfaces and infinite variety of design possible in both fabricated and molded pieces, exactness of reproduction of intricate patterns are major considerations in promoting plastics. With the child psychologist in complete command, design of toys for maximum educational development has put stringent demands on toy design and construction.

Literally just what the doctor ordered, plastic toys are ideal for the very young. Colors will not run or wash off in cleaning solutions or in baby's mouth. If molded with proper wall thickness, plastic toys are practically indestructible. They can be bitten, chewed with childish abandon time and again without danger. Even if they do break eventually, there are no rough, jagged edges to cut or scratch tender young skin.

Toy manufacturers have been dipping into the plastics field for several seasons. Plastics first appeared in the industry in the form of game pieces, chessmen, checkers and dice. These items were made from fabricated rods, cylinders or sheets which were cut, embossed, engraved or turned to produce the desired shapes. Blown hollow toys of cellulose nitrate were early performers in the infant world and are being given a new lease on life with the release of competition from Japanese and German markets.[1] Transparent sheet

[1] "Toying with Nitrocellulose," MODERN PLASTICS, April, 1941, p. 45.



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stock and acetate dopes helped to develop the model airplane field—still tops in popularity.

Later, molded plastics cropped up in toy parts such as transformers, railroad ties, bridges and whistles. With increased development of injection molding technique, miniature automobiles, musical instruments, soldiers, indians, animals, banks and toy cap pistol grips made their debut.[2] Last year's crowning achievement was the introduction of the Magic Skin doll with an injection molded cellulose acetate head.[3]

After an initial flyer into the plastic field, some of the toy manufacturers have expanded into plastic production of allied and even unrelated products of various types. For example, over two years ago, Hoover Products, Inc., strung together a series of brightly colored molded urea disks—very much like a collection of manufacturers' color samples—and marketed them as *Plakie* teething rings. Today the company features a complete line of plastic rattles, floating bath toys, nursery lamps and baby feeding sets. F. M. Hoover, president of the company, writes: "Since its inception, we have actually bought and sold 3,415,591 parts which went into baby toys. Of course safety is a major consideration. We are seriously limited in colors as we use only those which will not bleed when boiled. We inform customers that the disks can be boiled in an

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[2] "Toys for Sale," Modern Plastics, August 1939, p. 60.
[3] "Oh, You Beautiful Doll," Modern Plastics, December 1940, p. 35.

3—Colorful cast phenolics for infant's toys in various shapes. **4**—Screw type toy puts youngster on his mettle. **5**—Rods and cylinders of bright cast phenolics make ideal baby toys. **6**—Real aid to mother are bright ureas that are non-inflammable and can be sterilized at home, and need not be labeled, "handle with care"

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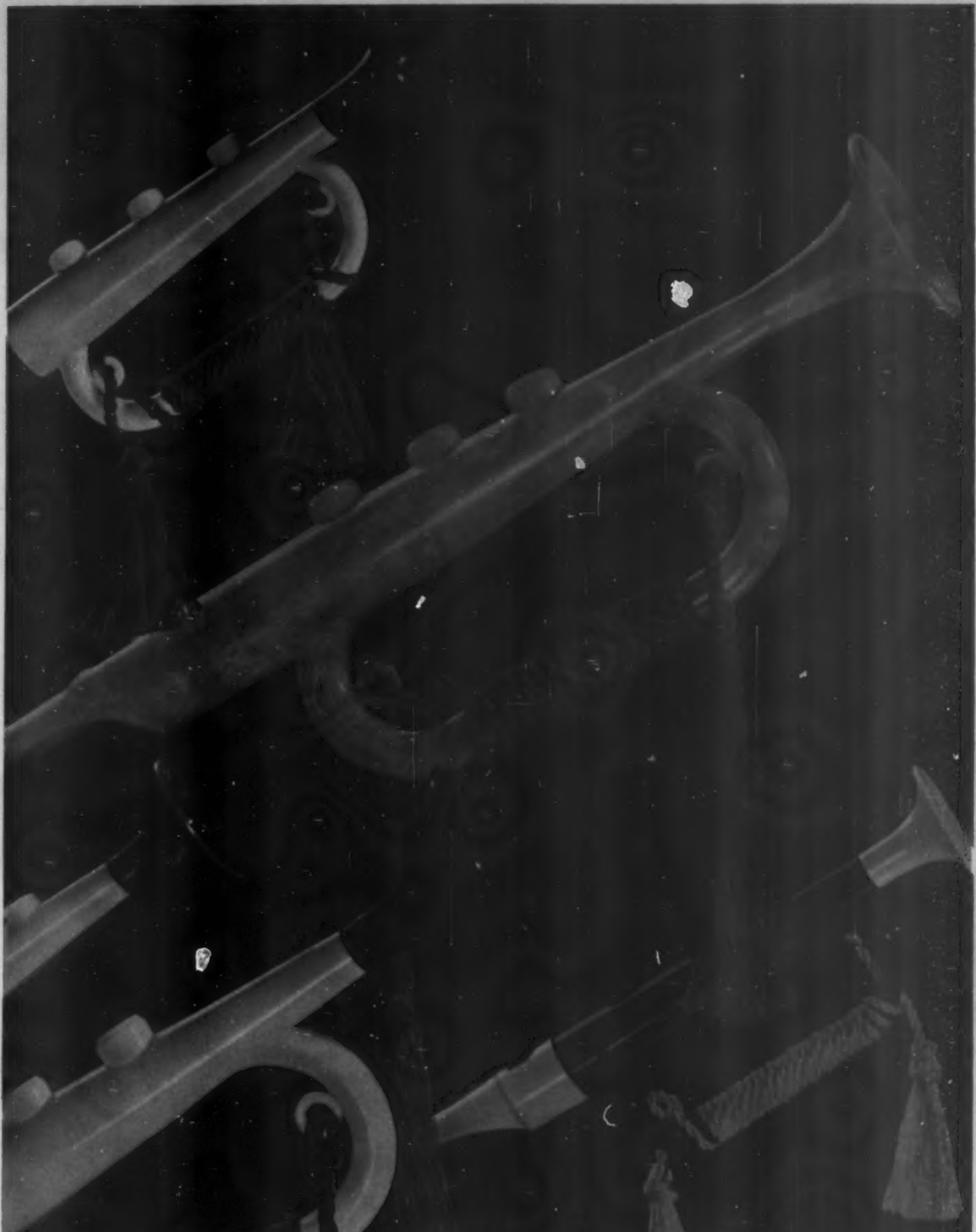

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COLOR PLATES COURTESY TENNESSEE EASTMAN CORP.

7—The Winnah! Bugle Boy and its big brother, Cadet Bugler, award winners in the 1940 Modern Plastics Competition. They are molded of brilliant cellulose acetate, and gayly wound with braid. Within 90 days after Bugle Boy was put on the market, America bought over a million—a brilliant sales record for musical toys that really work

COLOR PLATES, COURTESY MONSANTO CHEMICAL CO.

open pan for two minutes. We stress non-inflammability because it provides an additional feature of safety. In our initial survey, we discovered that disks less than two inches in diameter were an element of danger since they could be lodged in the throat. Walls are sufficiently thick to prevent chipping. For rings, beads or rods used in connection with the disks, cellulose acetate or products with similar strength and durability are used. (See Fig. 6.)

"Compact feeding dishes with several compartments have reinforced sides with internal ribbing for strength and are heavy enough—7 1/2 oz.—to prevent children from picking up plates and spilling food. The sloping sides and deep recesses teach children eye and muscle coordination and start correct eating habits."

Similar stress on psychological development is seen in a variety of baby toys brought out by other manufacturers in the industry. (Figs. 1–5.)

From England, Child Expert Hilary Page has brought a line of "Sensible Toys," which encourage children to think for themselves, develop skill and digital manipulation and encourage perserverance. Mr. Page has a practical approach to plastics as well as to educational

8—Playing house will be the favorite game of the little girl who owns a bright polystyrene tea set (opposite page). There are no sharp edges to cut or scratch and dishes "can take it." **9**—Convoy of injection molded cellulose acetate ships with full naval equipment. Above—sprue, with 4 parts for 2 ships molded at one shot. **10**—Molded phenolic gasoline engine for a model airplane runs like the real thing. **11**—Model airplane makers find cellulose acetate propellers will withstand hard knocks without breaking or cracking. **12**—Molded toy soldiers are of cellulose acetate, painted with realistic detail. They're light and practically unbreakable

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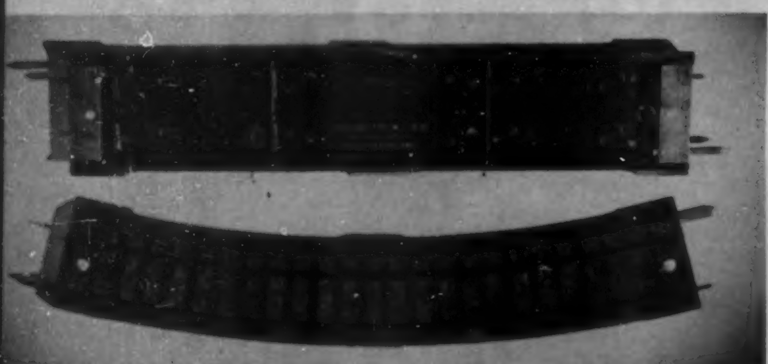

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psychology. "I think that plastics is the ideal material for toys for babies and young children," he said "because it will stand up to any amount of biting, sucking, gnawing and can be washed indefinitely. I have always been very careful not to be tempted into trying to produce a toy which looks big value but is so thin that it will break. I think it is of paramount importance that plastic toys should withstand being thrown against hard surfaces or stone floor.

"Two years ago we produced in England a toy which consisted of 12 nesting cups which fit inside one another and built into a pyramid when turned upside down. These were molded with too thin a wall. When the toy was first produced and marketed, it was perfectly satisfactory but when it had been in the home for a few months, constantly exposed to light and dry atmosphere, it became so brittle that the cups would break if a child sat or fell on them. This resulted in so many complaints that it almost convinced several buyers that plastics was not the ideal medium for babies toys. We thickened up the section on this particular toy and since then have had no such trouble. In inventing subsequent plastic toys, I have been very careful to see that we do make the walls sufficiently thick. If one bad plastic toy gets into big circulation in any market and eventually becomes broken, it may make many mothers decide against them for future purposes."

D. C. Dillon, Jr., President of the Dillon-Beck Mfg. Co., who designed and molded a complete bathtub fleet—submarines, freighter, cruisers, airplane carriers—tells us that the reception of these toys has been such that all available molding capacity is completely engaged and postponement made of a large plastic airplane which was to supplement the line. (Fig. 9.)

Child nor adult has ever been able to resist the appeal of toy trains. A. C. Gilbert, who have installed their own molding equipment, produce both curved and straight sections of molded phenolic track for their toy railroads (Fig. 14) and plan other parts in the future. The Lionel Corp. uses plastics in a number of parts in their scale-model rolling stock. On one model of a caboose the windows are of vinyl sheet, polished on the outside and matte-finished on the inside to diffuse the light from the interior. Tail lights of the same caboose are molded of polystyrene in such form that light from a single lamp in the back of the caboose is "piped" out to the sides and behind the trains. The effect produced by the interior light shining through the plastic windows and tail lights is so realistic that it has given tremendous impetus to sales. (*Please turn to page 90*)

13—Sides of this toy train are molded of cellulose acetate in one piece, thus eliminating necessity for carving or machining slats and reinforcing ribs. **14**—Molded phenolic tracks for tiny railroads. **15**—"Krazy Top," magnetized wheel of both phenolic and urea, spinning at high speed. **16**—Beautifully carved cast resin is used for this hand made Staunton chess set. Rods were roughed to within $^1/_{32}$ in. of finished diameter

Miniature models plan a room

THERE are all sorts of ways to plan a room, and one of the most expensive and foolhardy is to buy all of the furniture and then hope and pray that it fits into your room. Another way, a wiser and more economical way, in which to "re-do" your room or furnish a new apartment or home is to use scale model furniture. These pieces are placed upon a floor plan that corresponds exactly with that of your room. Models of clear acrylic plastic have been fabricated by one furniture company for dramatic displays in department and furniture stores. The brilliance of the material attracts attention, and certain lighting effects are possible with the plastic that could not be achieved with wood or other opaque materials. The sets of miniatures that are sold to customers are made of wood. No longer is it necessary to groan at the thought of having to shove furniture from one end of the room to the other in a frantic effort to get a new effect. Now, you can pick up your piano between thumb and forefinger, with nary a strain on your back, but a gleam of delight in your eye as you place the piano in a position so that it takes up less space yet shows off to greater advantage. Furnishing your new abode will be a real pleasure, (*Please turn to page 98*)

Clear acrylic plastic for miniature furniture makes it easy to plan your room by changing the pieces around. They are ideal for promotional purposes and a practical way to try out new ideas before buying actual full size pieces to live with

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PLASTICS

1 Plastics score again in this attractive Catalin radio which comes in 5 contrasting shades and is run most economically as a 5 tube set. Colors are onyx with ivory trim; alabaster with red trim; alabaster with blue trim; maroon with ivory trim, and alabaster with ivory trim. Fabricated by Plastic Turning Company for De Wald Radio Mfg. Corporation

2 No fishing for the car key! It's attached to a bracelet of Tenite molded in red, yellow, green or ivory by Gits Molding Corp. S. C. Johnson and Son, Inc., offers it as a premium with each can of Carnu—lively bait for those who want spic and span cars

3 An end to cauliflower ears—dread souvenir of wrestlers! Wolverine ear-guards can withstand 200 lbs. of pressure against the head, are lightweight and close fitting. Molded of Lumarith by Michigan Molded Plastics for Raymond V. Roberts, University of Michigan Athletic Trainer

4 Small palm-sized, the Aceliner stapler will pin, tack, hand fasten or staple without jamming. Lightness and delicate balancing are due in part to the Tenite handle molded by Sinko Tool Manufacturing Co. for Ace Fastener Corporation

5 Full foreign reception is yours with the Crosley "Glamor-Tone" radio which has a complete range from 6 to 18 megacycles and from 550 to 1600 kilocycles. Attractive case is a high glass ivory baked-on enamel finish over Bakelite phenolic. Molded by Chicago Molded Products Corp.

6 Savings of 75 percent over cost of steel was effected by U. S. Gypsum Co. in its Perf-A-Tape sheetrock joint knife molded of black Lumarith by Chicago Molded Products Corp. The smooth surfaced flexible knife, used for joining Gypsum wall board panels which have a shallow channel at edges, will not mar board surfaces. Perforated tape with special adhesive is cemented into it

IN REVIEW

7 Function and decoration combine to make Durez plastic chair arms a comfortable addition to the Electroliners (North Shore Line between Chicago and Milwaukee). They are molded in various colors by Van Norman Molding Co. Sleek and shiny, they won't crack, peel or splinter!

8 Large compacts $2^1/_2$ in. square are "Fethalite" and jewel-toned. Injection molded of Lucite by Arpin Products, Inc., for Sig Dawer. A double beveled glass mirror showing through the cover provides a new convenience—a mirror that can be viewed without opening the case

9 American Airlines lets no mail slip through its fingers with the new transparent Plexiglas mail chute. Installed to receive messages between radio and flight control rooms which are separated by sound-proofed walls, the chute is easily seen by the operator. Fabricated with parts drilled and tapped rather than bent or molded, by L. Voges Mfg. Company

10 Boon to the Little Woman is the moth destroyer unit of Durez! Housing consists of two sections threaded for secure fastening with inserts of fine mesh metal screens into which the death-dealing Expello crystals are placed. Molded by Eclipse Moulded Products Co. for Hamilton Beach Company

11 This compact, manually operated switch housing is molded from a heat-and-moisture-resistant Bakelite phenolic, high in electrical resistivity. It is made for the simple lamp design and operated in a clockwise direction. Unit measures $1^3/_8$ by $1^1/_8$ by $^1/_{16}$ in. Introduced by the Jefferson Electric Company

12 Clarity and color of plastics lend themselves beautifully to new manicuring accessories molded by Sterling Plastics Co. for Schnefel Brothers Corp. The "orange stick" is translucent Bakelite cellulose acetate. Other manicuring instruments are of clear polystyrene

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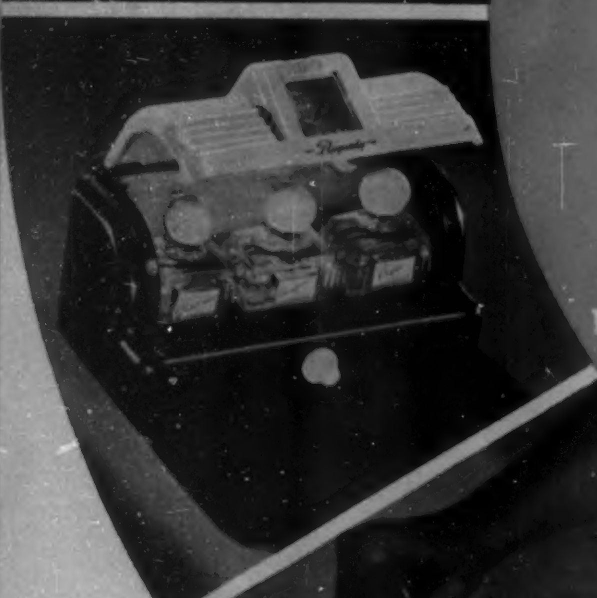

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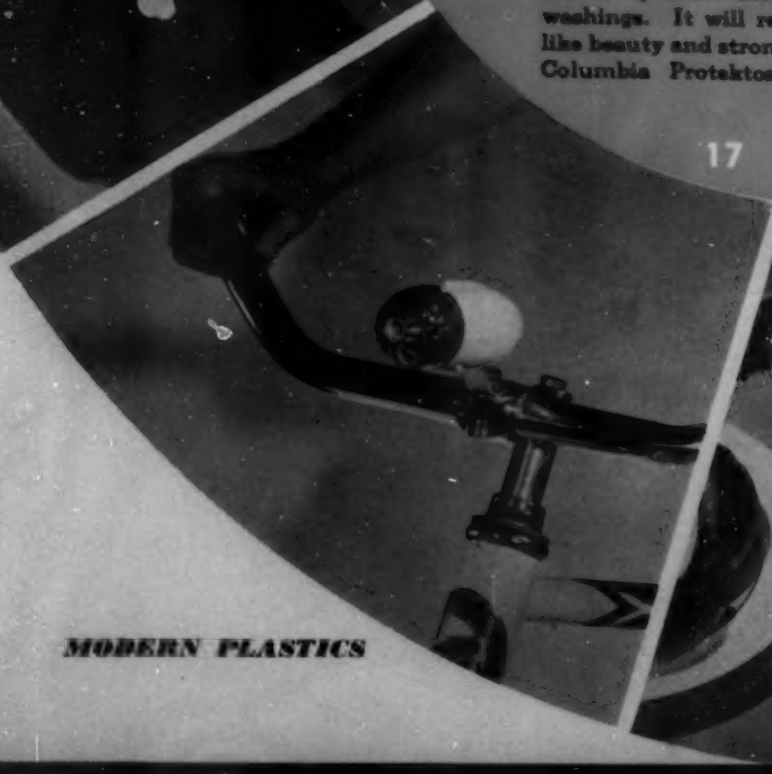

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PLASTICS

13 Smart sales promotion on the part of Frigidaire Div. of General Motors Corp. launched this Lumarith bank, refrigerator in miniature. It illustrates features and points out that a few cents a day will eventually buy a box. Molded by Michigan Molded Plastics, Incorporated

14 No need to worry whether or not the fluorescent light will go on with this Indicating Glow Starter. It is a starter switch which glows instantaneously when snapped on. It has a phenolic base and a translucent Beetle top which reflects the light. Molded by Universal Plastics Corp. for Abott Fluorescent Co., Inc.

15 Rich warm colors in transparent Lustron finds effective use in this graceful bowl for salads, fruit or flowers. The plastic is unaffected by fruit acids or continued washings. It will retain its crystal-like beauty and strong color for years. Columbia Protektosite Co., molder

16 Tune in on your favorite perfume with the Rhapsody, tricky Tenite "radio cabinet." The case is complete with mirror and three scents of perfume. It can be used as a trinket or cigaret box when emptied. Colors: blue, green, ivory, orchid and pink. Size—$4\frac{1}{2}$ in. long, 2 in. high, 2 in. wide. Molded by Columbus Plastics Products, Inc., for Millerand, Inc.

17 Night cycling is made safe by Delta Bike Lights, with lenses molded of Lustron by Owens-Illinois Glass Co. Unaffected by rain, moisture or sunlight, a clear polystyrene lens is used in front, and a ruby-red one is on the tail light

18 Start the day right with a colorful breakfast table, set with Tenite accessorise. Cutlery handles are molded by Erie Plastics Co. for Ontario Knife Co., egg cup molded and manufactured by Connecticut Plastic Products, Inc., and Allite seasoners molded by Allite Mfg. Co.

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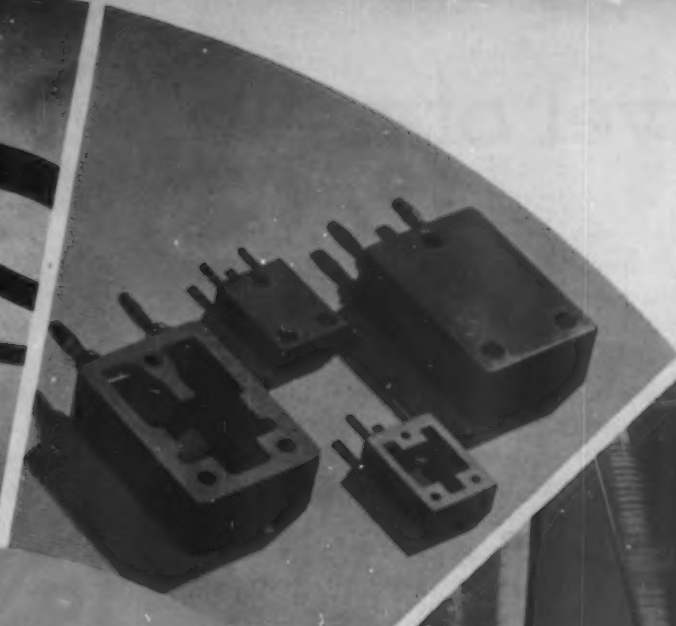

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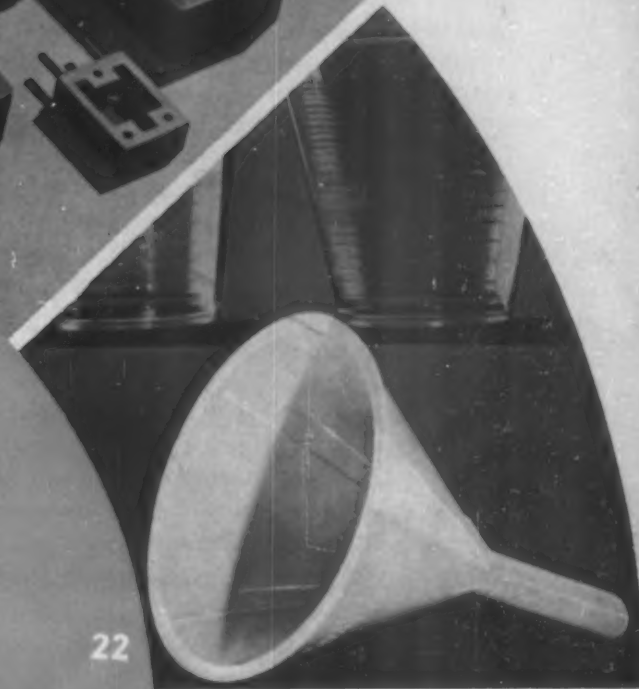

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IN REVIEW

19 Dress accessories of charm and character have been designed by American artist Marian Weeber for B. Blumenthal and Co. and fabricated into buttons, earrings, hooks and eyes of Celluloid by La Mode Plastic Co. Note tiny realistic details

20 No need to scream when you see a bug because "bug deflector" will see it first! This concave transparent triangle is mounted on an automobile hood to create air currents which will deflect insects from the windshield. It was designed especially to minimize automobile driving hazards. Fabricated of Pyralin by Henry Mfg. Company

21 Robinson Mfg. Co. presents a handsome pen and ink set consisting of three molded parts. Textolite is used for base and a special Bakelite for domed cover which screws over a glass ink bottle. The pen is of Catalin and hard rubber. Molding by General Electric Co. Designed by George Voges

22 Camera enthusiasts will find these new graduates and funnels for the photographic laboratory an aid to good work. They are molded of Tenite. Material is uninjured by contact with most photographic chemicals. Molded by Modern Plastics Co. for B. and W. Photo Utilities Co.

23 Clear transmission is made possible by these newly designed radio crystal holders of a special Durez molding compound. The characteristics that make the air waves trouble-free are chemical stability, moisture and heat resistance and the mechanical strength of the material. Molded by Bliley Electric Company

24 Sellstrom Mfg. Co. introduces one of its new models of industrial protective goggles with four molded Durez parts. Rim screws to the shield and holds the lens tightly. A metal vent screen is clipped into the shields. Lightweight and strong, the housing is smooth to the skin

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Marvel of merchandising

Fabricated plastics run the gamut from packaging and display to home accessories

by RICHARD M. GREENE*

THE progressive merchant of 10 years ago must have thought wistfully of a package that would sell his goods, keep them clean and allow the customer to examine the merchandise without touching it. Such a paradox was solved with fabricated plastics, slow to maturity, but now a husky, thriving youngster.

About 1930 the first cellulosic transparent sheet stock for packaging was put on the market. Although it satisfied the merchant, the fabricators were loathe to change their methods. From 1930 to 1935, however, the industry went ahead so that today articles from cigars to soap boxes, and displays ranging from pearls to pipe racks, take advantage of cellulose nitrate sheet stock.

For the purpose of clarity let us define fabricated plastics as those articles and products made of sheet and rod stock, machined and otherwise constructed by means of tools other than dies and molds. In exploring the field of fabricated plastics, let us first consider cellulose acetate and cellulose nitrate sheet stock. With the introduction of cellulosic transparent sheet stock a means was created to package and protect merchandise, yet keep it in full view. Although millions of yards and corresponding millions of pounds of thin transparent material are used for wrapping all kinds of products, this is not, strictly speaking, fabricated material, since only sheet stock is used without any additional manufacturing process, other than machine wrapping.

Cellulose acetate and nitrate materials from .0075 in. thick up to .040 in. thick and even heavier, are used in impressive volume in the form of fabricated boxes and containers. They are of three types: overlapping or flap fold at the joints; curled edge, and patented beaded edge.

Easiest and cheapest to manufacture is the flap fold construction and it is, furthermore, most widely used. Its principal virtue is low cost, while its limitations include lack of structural strength and absence of a mechanical feature to give eye-appeal.

The curled edge construction costs slightly more and is stronger and more attractive, although the irregularity of the curl and its looseness are drawbacks. The patented beaded edge type is strongest and best looking. This type uses an actual plastic bead, often reinforced with a center wire core as a common member to which are cemented the two adjoining pieces of sheet stock. In order to enhance its appearance, the bead is made in metallic and colored effects. This construction is used for packaging where rigidity and permanence are required. Boxes and shields made of this

* Joseph H. Meyer Bros.

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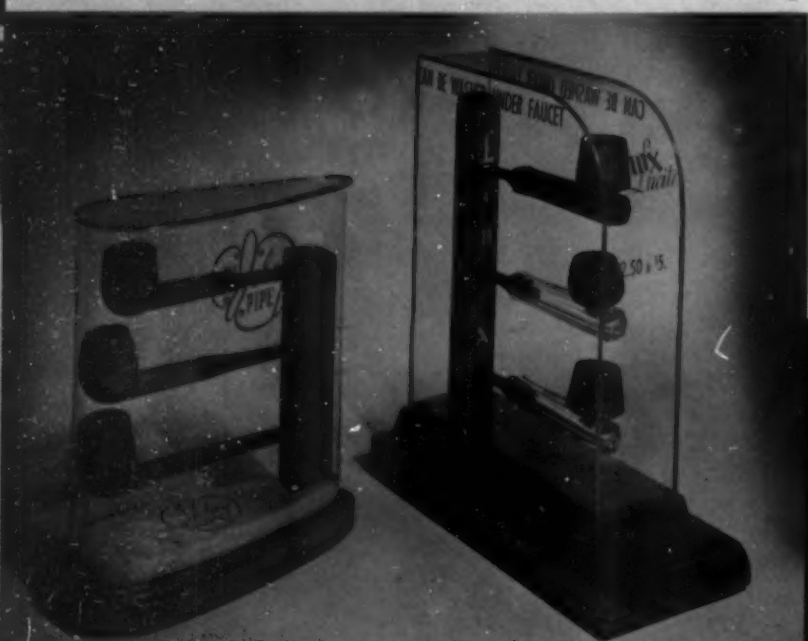

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1—Following the general outline of the pipe itself, this transparent show-case makes an effective display on Tobacconist's counters. **2**—Bent rods of acrylic in a graceful sweep with letters jig-sawed from sheet stock, display popular wrist watches with plenty of "sell." **3**—An effective display keyed directly to the prospective bridegroom—lovely jewels set in a cast resin background. **4**—This sparkling year size figure is made of clear acrylic. It can be washed with soap and water to keep it bright and shiny

construction can be guaranteed against separating at the joints, hence they are employed where re-use of a container and permanence are an important sales argument. It is easy, too, to achieve a variety of shapes with this construction (Fig. 1). These shapes are all covers, used over a plastic, wood, or cardboard base. Extending this principle, we find that many other shapes can be made, and we come to an entirely new field—that of novelty boxing. Such novelty boxes have been produced economically mainly because of the ease of manufacture, but working with cellulosic sheet for such production requires no less skill than craftsmanship in any other field of plastics. Precision cutting of stock; obtaining tight joints that will not separate; designing for ease of construction and sturdiness, all require practice, experience, proper equipment, and often mechanical ingenuity.

Novelty boxes are sold in large quantities in better department and specialty stores. Modern closet shelves are dressed up with large, clear and colored acetate hat boxes, some with sliding panel fronts. Shoes are similarly protected. The hat stands are plastic disks mounted on a plastic shank; the heavy bar on which are hung dresses and coats is probably a thick rod of acrylic resin material. The side supports of the rod are of the same material; the coat hangers themselves are simply shaped rods of acrylic or phenolic resin stock. Bureau drawers contain small transparent boxes wherein are stored cosmetics, spools of thread, hosiery, gloves or handkerchiefs. Facial tissues are encased, dustproof, in acetate boxes or dispensers as well as sanitary face powder and puffs. Linen closets boast of a large variety of transparent blanket boxes. Furs are stored in plastic boxes which, being transparent, require no further labeling.

In addition to such luxury items, more utilitarian fields employ such containers. Laboratories of all kinds use shields known as bells to protect instruments and to keep delicate parts dust-proof. Formerly made of heavy and brittle glass, costly to replace and difficult to handle, these shields today are made of acetate materials, sometimes with a wooden frame for reinforcement, more often made for structural strength with the beaded edge. These instrument covers may take the shape of a large upright cylinder to cover a microscope; or they may be oblong, to encase a calorimeter. All are light, solidly built, resilient, transparent, and inexpensive.

The Food industry also profits for food covers have been developed. Public food laws are becoming increasingly stringent, hence more and more types of food must be kept covered for protection against flies and dust. The acetate cover, on a wood, wire or plastic frame, forms a light, cheap, strong cover.

Advertising displays made of plastics are becoming more and more important in the fast growing display industry. In no field is the saying "Show, and sell" more true than here. Hence transparent acetate principally, and acrylic resin materials secondarily, find wide use in display fixture construction and design.

The basic reason for the success of transparent plastic displays is that they draw least attention away from the merchandise exhibited in them. One look at the displays illustrated proves this point. Notice how perfectly the merchandise is kept in view without conflict, for the prospective buyer's attention. Pipes, or leather goods, linens, children's clothes or any small wares are best kept in full view, yet are sanitary and protected from soilage and pilferage, by transparent plastic counter and window display units.

A further important display use of plastics is in the manufacture of counter signs. For this purpose cast resin and acrylic materials are (*Please turn to page 94*)

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AMERICA'S MODERN PLASTICS EXPOSITION

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PLASTICS IN PACKAGING
NEW PLASTICS
MODERN PLASTIC EXPOSITION

3

POLAROID
MODERN PLASTIC EXPOSITION

Parade of progress

THE welcome curiosity of an inquiring public concerning plastics is finally satisfied in "America's Modern Plastics Exposition," undoubtedly the most complete, dramatic and comprehensive exhibition ever assembled for the industry. Collaboration of C. A. Breskin, publisher of MODERN PLASTICS magazine, and W. L. Stensgaard and Associates, Inc., has resulted in a show for which department stores throughout the country have been clamoring. (See May 1941 issue for complete details.)

Pictured here are highlights of the exhibit as shown by the Joseph Horne Co. department store, Pittsburgh, Pa., which is typical of the type of presentation set up for top-flight department stores. Because of its great success in Pittsburgh, the exhibit was held over for an additional two weeks. It then was shown at the Fair Store, Inc., Chicago, Ill. Prior to the Pittsburgh showing, the Exhibit was at Elder and Johnston's, Dayton, Ohio.

Every store showing the Exposition is serviced with a well-planned, comprehensive publicity and promotional plan for in-store activity as well as press and radio publicity in the city. Prizes are also offered for an essay contest, "The Future of Plastics," sponsored by this magazine for students and adults alike.

Since an accurate picture of the Plastics industry is incomplete today without recognition of national defense, several new display units have been added to inform the public just how Uncle Sam uses plastics.

An American flag, described as the largest plastic flag existent, is dramatically displayed in front of a black velvet drop. It dominates the section on National Defense and sets the tone for that section.

Awareness of the increasing interest of automotive manufactures is seen in a fascinating panorama of the cars of the future. Miniature models of gayly colored plastics speed down a winding highway, presumably the highway of tomorrow!

Shadow boxes hold the majority of large displays. They conform to any requirement of store facilities and are equipped with lighting units which show the objects to best advantage. Each section is 4 ft. high overall by 8 ft. long and 17 in. deep. The legs on each unit are removable, as are the ends and the sides. Double sections, which can be set up at right angles, fold together when legs and sides are detached, thus becoming their own shipping containers.

7

1—Dramatic entrance to the Jos. Horne presentation of America's Modern Plastics Exposition. **2**—Largest American flag in plastics, part of "Plastics in Defense" section. **3**—One section of the exhibit showing shadow box units and home furnishings. **4–5**—Defense applications are an important center of interest. **6**—A glimpse into the future of plastics in motor-cars. **7**—This amusing little exhibit graphically shows the elements of nature in plastics

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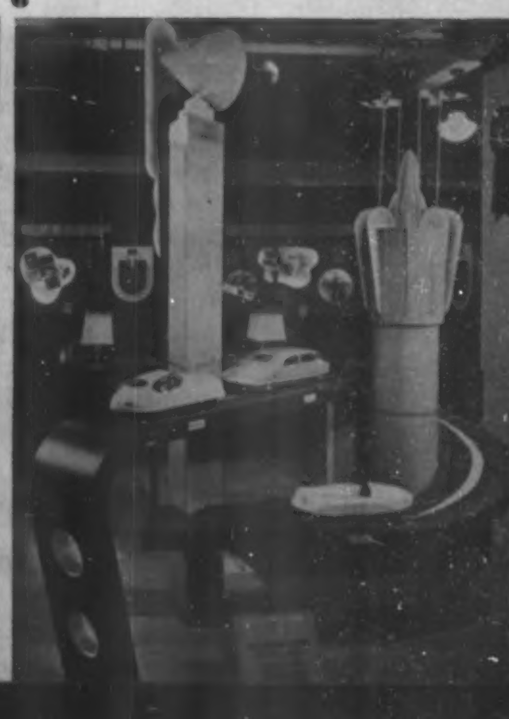


PRODUCT DEVELOPMENT

Flowers for cosmetics

Hand-carved, delicate flowers imprisoned in pale-pink, translucent plastic make a double duty accessory of new cosmetic containers. Under the fanciful name of "Desert Flower" (which refers to the American desert flower, delicate and sturdy as the scents themselves) a complete new line of cosmetics has been boxed first in cardboard containers and then plastics. The attractive bait of refills and the beauty of the pink plastic containers which can be used for any number of things around the house have already made the line popular. The dainty decoration is hand-carved into the plastic covers. The very characteristics of the cast phenolic resin make it ideal for the purpose for which it is used. It is odorless, tasteless and hygienic and, furthermore, has an unusual range of transparency, translucency and opacity. The plastic is delivered in castings and rods which are carved, polished and lathe turned. Containers are machined on the inside to give a translucent effect. Closures are polished to transparency.

Credits: Mystile. material by Catalin Corp. for Shulton, Inc.

Band saw disk wheel

Solid phenolic disk wheels molded to very close tolerances, strong and speedy, have made the Boice-Crane band saw operate more smoothly, safely and 4 times as fast. Designed for maximum strength per unit of material, the wheel has tremendous resistance to stress and yet is light in proportion to its strength and speed. Each wheel weighs $2^1/_2$ lbs., or 5 lbs. a pair. The wheel speed is 1200 rpm; blade speed is 4400 ft. per minute. Other 14 in. band saws have a wheel speed of 600 rpm or thereabouts, presumably because their wheel of pressed steel or cast iron, weighing 12 to 16 lbs. per pair, cannot be rotated any faster without overstraining blades to the breaking point, since the inertia of the saw-driven idler wheel causes great strain on the saw. This strain occurs both in starting and stopping and also when the speed is reduced on the composition of load. With the use of the molded plastic wheels, running them even at 1200 rpm, the resulting blade strain is 20 to 40 percent less than has been accepted on other machines. Neat, streamlined in appearance the entire framework (see photo) is joined solidly together by thorough electric welding to make a single, one piece steel structure.

Credits: Textolite by General Electric Co. for Boice-Crane Co.

PRODUCT DEVELOPMENT

Phonograph tone arm

A molded phenolic has been the answer to a tone arm which would do the following things for a popular phonograph: reduce surface and mechanical noises, increase tonal reproduction, make records and needles last longer and reduce weight and reverberation. In the old arm the needle cartridge had to be made in two halves, assembled and then fastened at several points to the arm itself. Now, half the cartridge is an integral part of the molding. The cover is metal and is fastened to threaded bosses in the plastic. Furthermore the tone arm comes from the mold with a fine, smooth, glossy finish which needs no additional factory finishing. Elimination of the customary cartridge assembly by building the crystal and chuck directly into the tone arm also assists in eliminating undesirable tone arm resonance. The use of screw terminals services the unit by making it unnecessary to use a soldering iron and eliminates removing the motor board or in any way disassembling the unit.

Credits: Durez molded by General Molded Products Co. for the Webster Electric Co. Fastening devices: Phillips head screws

Nasal pack

A surgical aid that makes extensive use of molded urea-formaldehyde has been invented by Dr. J. H. McMiller, for use after an internasal operation to prevent nosebleed (epistaxis). It has always been standard practise to pack the nose with vaseline gauze or cotton after nose surgery, particularly in cases where there has been a crushing injury to the nose. The McMiller instrument plugs the nasal passage by means of two small longitudinal balloons that are inserted and then inflated to the desired point. This provides a pack that closely adheres to the contours of the nasal cavities. The plastic is used as a brace to which balloons are attached, and as a container for the valve which inflates the balloons. The "nostrils," which are attached to it, are formed of hollow flexible tubes that run through the balloons. Fitting, as it does, snugly over the nostrils and the lower part of the nose, it was essential to choose a durable material that would be extremely light because patients generally wear the pack for 48 hours. The material is smooth, sanitary, odorless and can be molded to any shape desired with the necessary cavities as an integral part of the structure. The smooth surface resists abrasion.

Credits: Plaskon, molded by Peerless Molded Plastics, Inc.

PRODUCT DEVELOPMENT

Undersea air trap

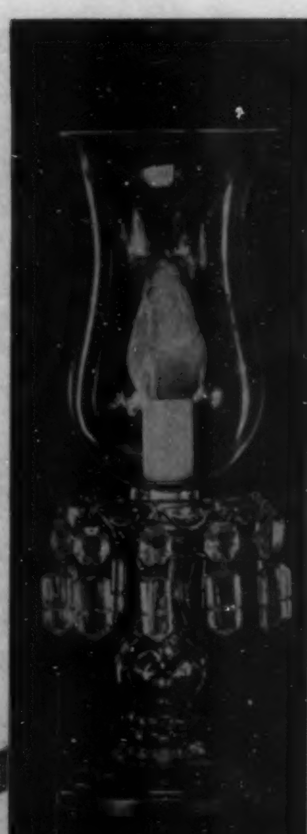
Filling stations are now located under water, but it is the lungs that stop for fuel this trip! At Wakulla Springs, Fla., an underwater trap for swimmers has a roof of clear methyl methacrylate plastic, formed in a half cylinder shape, with ends of solid cypress and an approximate radius of 18 in. Air is pumped into this half-cylinder through a hose. The cylinder is held to the base of the trap by four three-foot studs. The base is a rectangular box 14 in. deep and filled with ballast to anchor the trap to the floor of the springs. A swimmer merely dives to the trap, swims in between any two studs and sticks his head up into the large air space. Four swimmers at a time may enter the box and converse while "refueling." The swimming coach observes his students as they swim about him. Swimmers take from 3 to 5 minutes to accustom themselves to water pressure. The trap is placed only about 8 feet down when used for coaching and 15 or 20 ft. below for undersea photography—its main objective.

Credits: Lucite, designed by Wakulla Springs, Inc.

Lamp prism pendants

American ingenuity once again finds a substitute in plastics to take the place of a European import. This time it is prismatic pendants for chandelier and lamp decorations formerly bought from Czecho-Slovakia, but now manufactured in this country of either methyl methacrylate or polystyrene. The tradition that prisms *had* to be made of glass died hard, smothered as it was, with sentiment for the gay tinkle of glass. After the first experiments had been made and the molder was satisfied with his article, there was a decided change of heart among purchasers of prisms. The sprues came from the mold, crystal clear and free of mold and flow marks, giving exactly the same appearance in size and cut as the glass prisms. They are injection molded with 4, 6, or 8 pendants on a sprue, depending on the size of the object. According to the molder, the only important operation here was a close watch for marks that would mar the clarity of the prisms. Another improvement over crystal is that a uniformity of design and sharp precise outline can be expected from the mold. No polishing, or carving, is necessary—and they resist breaking and chipping.

Credits: Lucite and Bakelite polystyrene, molded by Boonton Molding Co. for Elite Glass Co. Incorporated

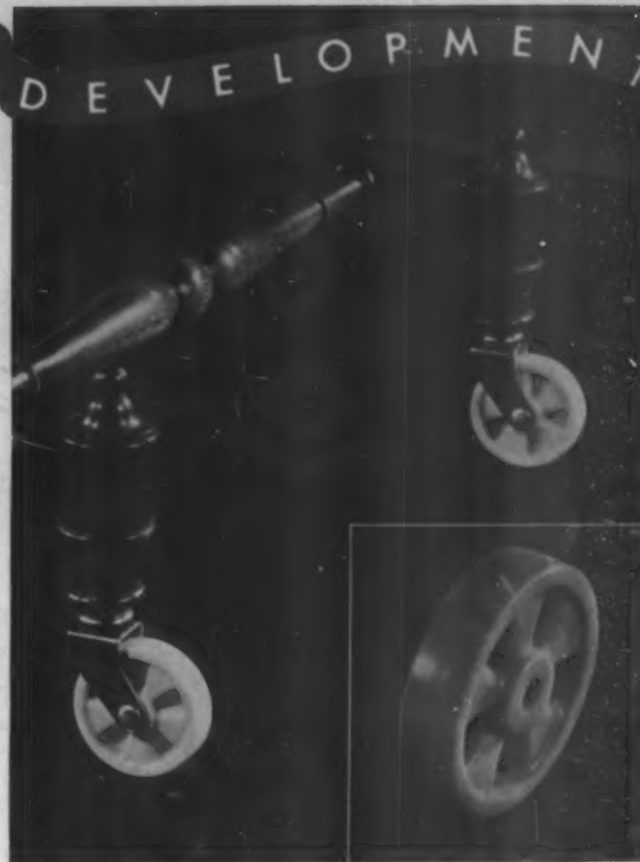


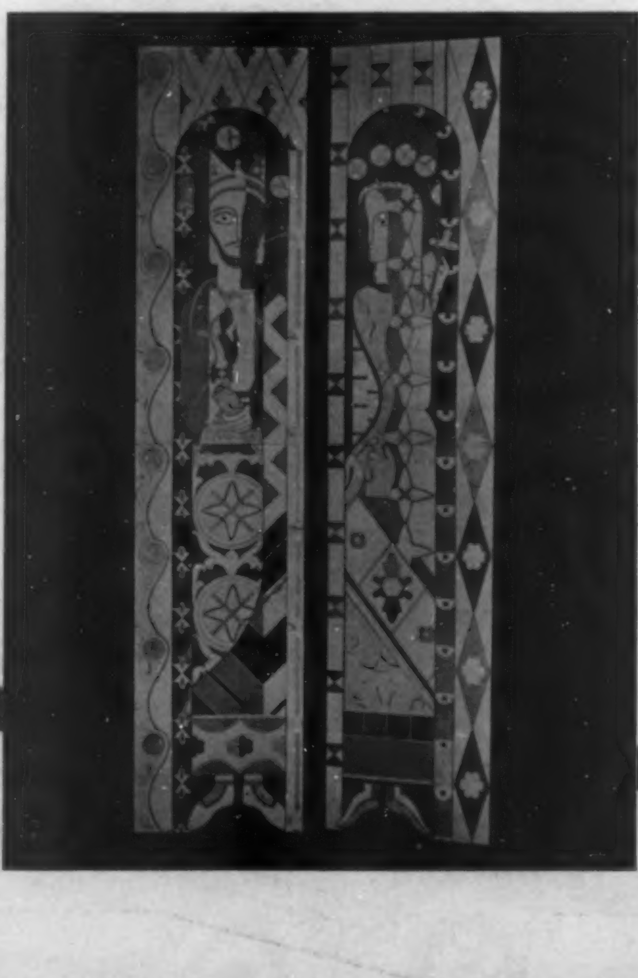
PRODUCT DEVELOPMENT

Furniture casters

The purely functional furniture caster has been given a new lease on life, and a much gayer one, through the use of plastics! The first colored casters in the furniture world will make its debut in a blaze of glory to match, blend or contrast with furniture. They are compression molded of urea-formaldehyde and come from the mold uniformly accurate to meet the requirements of precise balance so necessary for the support of heavy objects. The wheels are molded in a pattern of webbed, triangular-shaped spokes; broadest where they join the perimeter of the wheel thereby affording additional reinforcement. A whole new field of color is now open to the decorator who had formerly thought of the caster simply as a mechanically perfect gadget to support furniture. It can be made as unobtrusive or evident as need be for the particular decorating job. The plastic casters possess all the former qualities of strength, resistance to shock and friction required and do not need oil to keep them mobile, nor do they get clogged with dirt.

Credits: Plaskon, molded by General Electric Co., for The Bassick Company



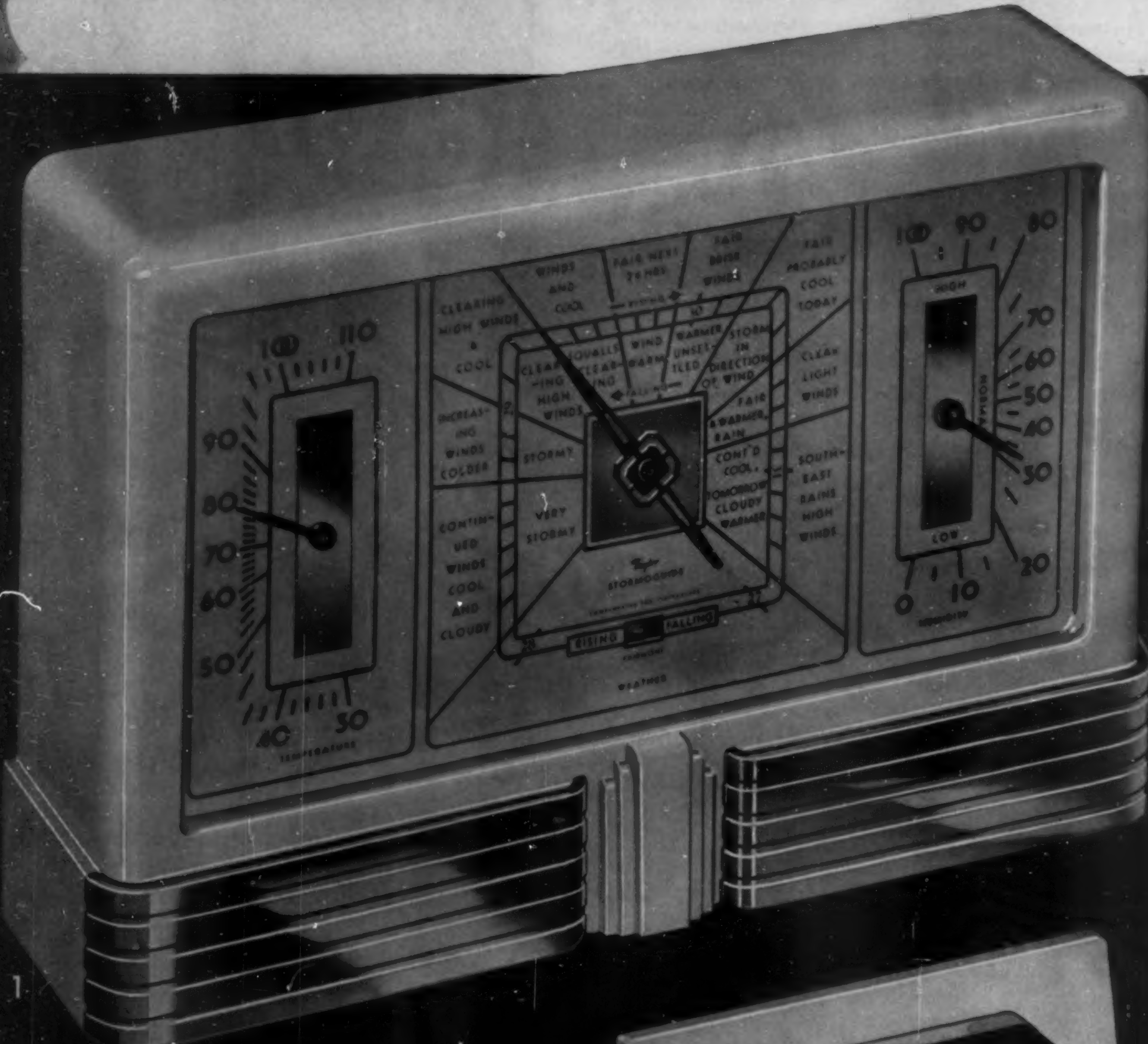


Laminated door panels

Leave Alice Donaldson alone in her studio with enough material and she'll come up with a new idea. This tim it is a pair of laminated plastic doors with an ecclesia tical motif, presented at the Tommi Parzinger sho "An Exhibit of Religious Art", N.Y.C. The doors, whi swing together, are 18 in. by 72 in. The materi is similar to that used by the designer for a prize winne in 1940 Modern Plastics Competition. Designs and fabrics in original colors are incorporated in urea-laminated sheets. The sheet is unaffected by humidity or temperature changes. It is stain-proof, heat-resistant, permanently finished and easily cut and machined. The laminate is available in different finishes and thicknesses. The sheets themselves are 36 in. by 42 in. Decorations, solid patterns or colors may be applied to both sides of a sheet and thin sheets may be made translucent. There is an unlimited line of pigments and textures for architectural purposes, such as doors, floors, baseboards and bathroom walls. It is the perfect thing for veneering furniture; murals may also be painted in this medium.

Credits: Plasdecor designed by Alice Donaldson. Beetle urea by merican Cyanamid & Chemical Corp. Laminator: Plastics pt., General Electric Company

Plaskon Fills Dual Role



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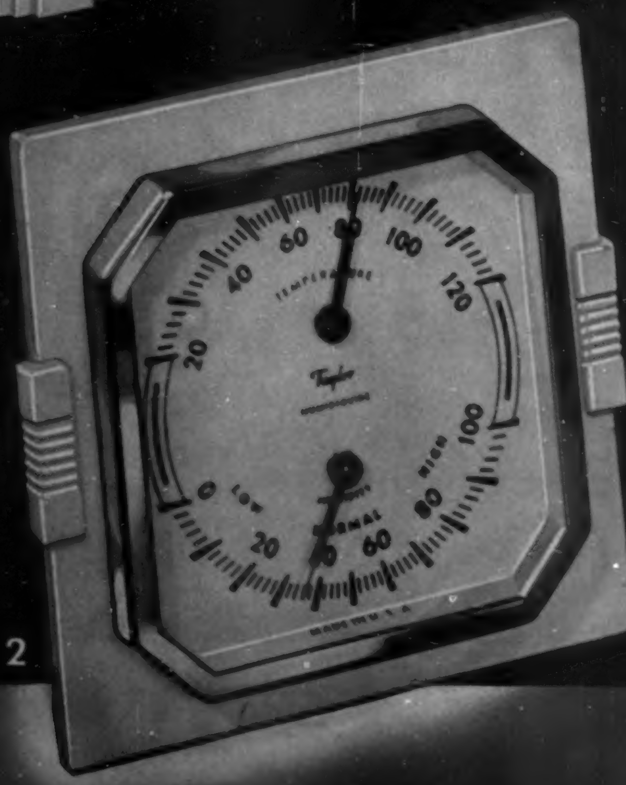

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Taylor instrument cases numbered 1, 2 and 4 are products of Diemolding Corp., Canastota, N. Y.

Taylor compass case numbered 3 is a product of Rathbun Molding Corporation, Salamanca, N. Y.

in Production Problems

In helping the public "keep its bearings" and its weather eye cocked, the Taylor Instrument Co., Rochester, New York, employs the distinctive beauty and adequate strength of Plaskon Molded Color for these instrument cases.

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1333. Round base 3 in. diameter; 3/4 in. overall height; 9/16 in. diameter center opening

1334. Ridged cap 2 in. diameter; 1 1/2 in. overall height; 7/16 in. diameter center opening

1335. Three decker cap, decorated top 3 in. diameter; 2 in. high; 7/16 in. diameter center opening

1336. Double decker base with openwork, 5 in. diameter, 1 7/8 in. overall height; 9/16 in. center

1337. Coffee, measure, 1 in. high; 2 1/8 in. overall diameter; 1 5/8 in. diameter base; handle 1 1/8 in. long by 1/8 in. wide

1338. Round base, 2 7/8 in. diameter; 3/4 in. overall height; 9/16 in. center opening

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Dimensional changes of plastics in boiling water

By REGINALD L. WAKEMAN*

ONE of the most significant of current trends in the field of plastics technology is to be found in the increasing number of industrial applications of its many products. Such uses are contingent upon the development of acceptable test procedures to determine the behavior of plastics under numerous conditions, the accumulation of precise data concerning their performance, the evaluation of results, and the standardization of specifications for various grades of materials. The many electrical applications of phenolic laminated products led several years ago to the adoption of the invaluable N.E.M.A. specifications and classification for certain grades of this type of plastic, while the excellent work of A.S.T.M. Committee D-20 on Plastics is well known and of high utility.

Last year, this Committee, in cooperation with A.S.T.M. Committee D-9 on Electrical Insulating Materials, proposed a revised and much improved tentative method for the determination of "Water Absorption of Plastics." In a recent contribution to MODERN PLASTICS (Vol. *18*, No. 2, p. 119, et seq., October 1940), Dr. Kline and his co-workers at the National Bureau of Standards reported a portion of the experimental investigations upon which this procedure was based, giving a comprehensive survey of the behavior of many types of plastics when immersed in water at normal temperature.

A.S.T.M. Tentative Method D570-40T applies to water absorption at 25 deg. C. The present paper deals with the performance of certain types of plastics, especially phenolics, when immersed in boiling water for protracted periods. Although this investigation was begun prior to the appearance of the new A.S.T.M. method, similar conditions were observed in preparation of the samples, save that rectangular test pieces, 1 by $2^3/_4$ by $^1/_8$ in., were used throughout. Because of the attendant necessity for heat resistance, only a few thermoplastic materials were studied; i.e., those showing particularly good resistance to absorption of cold water. Hence most of the data given are for various types of thermosetting plastics. Comparisons with the behavior of these materials in cold water are also included. The results herein presented were obtained in the course of a long-range investigation undertaken at the Mellon Institute of Industrial Research in behalf of the Pittsburgh Equitable Meter Company.

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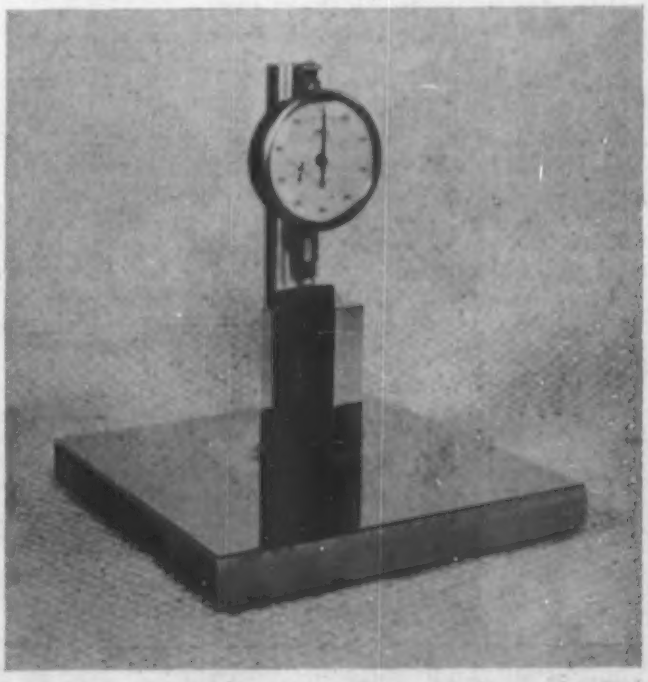
Apparatus and method for measurement of longitudinal swelling of plastics

It was desired to obtain as high a degree of precision as possible in the measurement of the length of samples of plastics which exhibit only slight longitudinal changes owing to water absorption. To permit such accurate determinations, a special instrument was devised:

One side of a 6 by 6 by $^3/_4$ in. block of hot-rolled stainless steel was turned in a lathe and polished to present a smooth, flat surface. The unfinished side of this plate was provided with three pegs to act as feet, and a $^3/_4$ in. diameter rod of invar, 6 in. long, was mounted so as to be exactly perpendicular to the finished side. This rod was centered with respect to one side of the base and was placed slightly to the rear of the center of the other side ($3^3/_4$ in. from one edge). A dial gage graduated in 0.0001 in. and having a total travel of 0.3000 in. was mounted upon the invar rod with the spindle pointed downward and at such a height that, for a vertical distance of 2.7 in. between its lower end and the steel base, it would be pushed upward through about one-half its path of travel and the dial would therefore indicate approximately 0.1500 in. A stainless

1—Instrument for measuring lateral swelling of plastics



steel guide was cut in the form of a block $\frac{5}{8}$ by $1\frac{1}{2}$ by $2\frac{3}{8}$ in. with one of the $1\frac{1}{2}$ by $2\frac{3}{8}$ in. sides relieved lengthwise for a distance of 1 in. from one edge and for a depth of $\frac{1}{8}$ in. from the surface. This guide was then attached rigidly to the base of the instrument in such a position that the upper end of a 1 by $2\frac{3}{4}$ by $\frac{1}{8}$ in. sample of plastic held in the recessed section would make contact with the point of the gage spindle. Thus, by firmly holding a rectangular sample of plastic of these dimensions against the guide, it was possible to duplicate exactly the position at which its length was measured. The instrument is shown photographically in Fig. 1. It can be readily standardized by means of two precision gage blocks, totalling 2.7000 in. in length. The accuracy with which the length of samples of plastics can be determined with this instrument is about ±0.0002 in. This error of reading is less than the variation in swelling from one sample to another of the same material.

Some work was done to compare the swelling of samples of plastics tested as received, tested after drying in a desiccator over calcium chloride for various lengths of time, and after drying in an oven for one hour at 105 deg. C., then cooling to room temperature in a desiccator. The last procedure was finally adopted in all cases. Test pieces were cut approximately 1 by $2\frac{3}{4}$ by $\frac{1}{8}$ in., although the 0.3 in. travel of the gage spindle permitted small variations from these dimensions without introducing any error of measurement. Surface polish of molded pieces was removed by sanding before testing. In all cases, measurements were made at room temperature, samples being cooled after boiling by allowing them to stand in water at room temperature for about 2 hours before examination.

Table I. Longitudinal Swelling of Certain Plastics in Boiling Water
(Specimens were dried for 1 hour at 105° C. immediately prior to immersion in water.)

Type No.[a]	Type of Plastic	Longitudinal Swelling Upon Immersion in Boiling Water, % After 1 Day	After 4 Days	After 1 Week	After 2 Weeks	After 1 Mo.	After 2 Mos.	After 4 Mos.	After 1 Yr.	After 2 Yrs.
	Laminated Phenolics									
1	Fabric base. Grade C	0.16	0.08	0.05	±0.00	−0.02	−0.04	−0.08	−0.16	−0.27
2	Fabric base. Grade C	0.11	−0.08	−0.24	−0.27	−0.37	−0.37	−0.59	−0.67	−0.84
3	Fabric base. Grade C. Graphite filled	0.33	0.27	0.20	0.14	0.14	0.08	0.06	−0.02	−0.13
4	Fabric base. Special for marine service	0.28	0.38	0.38	0.37	0.40	0.36	0.36	0.29	0.20
5	Fabric base. Grade L	0.20	0.14	0.08	−0.01	−0.01	−0.08	−0.10	−0.22	−0.28
6	Paper base. Grade XX	0.50	0.70	0.71	0.69	0.76	0.75	0.76	0.70	0.42
7	Impregnated wood veneer base[b]	0.25	0.24	0.23	0.22	0.20	0.15	0.19	−0.06	−0.24
	Molded Phenolics									
8	Chopped fabric filled	0.36	0.40	0.45	0.43	0.44	0.44	0.44[c]	0.41	0.35
9	Good heat resistance and low water absorption for electrical applications	0.33	0.52	0.57	0.61	0.68	0.84	1.03	1.06	1.11
10	Special for low water absorption	0.21	0.32	0.36	0.39	0.43	0.51	0.63	0.71	0.63
11	High heat and arc resistance	0.16	0.33	0.43	0.56	0.77	1.24	1.68	2.12	2.05
12	Acid resistant for rayon equipment, 4 min. cure	0.29	0.46	0.50	0.51	0.57	0.66	0.80	0.85	0.76
13	Same as type No. 12. $\frac{1}{2}$ hr. cure	0.21	0.34	0.42	0.49	0.52	0.58	0.61[c]	0.66	0.60
14	Acid resistant for rayon equipment	0.15	0.30	0.37	0.42	0.55	0.62	0.74	0.68	0.96
15	Mica filled	0.06	0.18	0.24	0.29	0.35	0.37	0.44	0.51	0.46
16	100% resin; no filler	0.07	0.14	0.18	0.27	0.38	0.48	0.61	0.72	0.82
17	100% resin; no filler	0.12	0.39	0.63	0.76	0.84	0.84	1.01	1.05	0.93
18	Approximately 100% resin. 4 min. cure. Sanded surface	0.28	0.50	0.63	0.76	0.78	0.98	0.96[c]	1.24	1.20
19	Same as type No. 18. 4 min. cure. Mold polished surface	0.24	0.46	0.60	0.74	0.79	0.98	0.99[c]	1.15	1.17
20	Same as type No. 18. 15 min. cure. Sanded surface	0.26	0.50	0.65	0.82	0.93	1.07	1.10[c]	1.40	1.35
21	Same as type No. 18. $\frac{1}{2}$ hr. cure. Sanded surface	0.37	0.60	0.74	0.84	0.84	0.99	0.99[c]	1.20	1.16
	Other Phenolics									
22	Cold-molded, asbestos filled	0.15	0.07	0.03	0.02	−0.03	−0.06	−0.08[c]	−0.26	−0.52
23	Cast	8.43	8.81	7.75	6.77	4.51[c]	warped and cracked after immersion 1 day			
	Miscellaneous									
24	Cashew nut shell oil—formaldehyde cast resin	1.16	1.46	0.95	0.81	0.62	0.51	0.39	0.27	0.16
25	Polystyrene. Molded	−0.30	−0.35	−0.46	−0.58	−0.59	−0.85	−1.35	....	−1.46
26	Vinyl chloride-acetate copolymer	0.70	3.44	5.52			Disintegrated			
27	Hard rubber[b]	0.30	0.64	0.93	1.45	2.35	3.55	4.97	8.04	....
28	Hard rubber	0.11	0.24	0.38	0.56	0.84	1.52	2.16	3.92	7.52
29	Hard rubber[b]	0.12	0.25	0.33	0.49	0.93	1.33	2.12	....	6.75

[a] A type number is assigned each commercial product tested for convenience in comparing results in all of the tables. Products bearing the same type number were all supplied by the same manufacturer under the same trade designation.
[b] Samples thus indicated measured approximately $\frac{1}{2}$ by $2\frac{3}{4}$ by $\frac{1}{8}$ in.
[c] After 3 months of immersion.

Longitudinal swelling of plastics in boiling water

Table I shows the increase in length of typical commercial grades of various plastics. The values reported are experimental data for a given sample of each type. Check determinations run upon a second sample of each type agreed, in most cases, with values reported.

Study of the data given in Table I yields the following conclusions:

(1) C and L grades of cloth-base laminated phenolic increase in length approximately 0.2 percent after one day of immersion in boiling water. Upon continued immersion, the length decreases progressively from the maximum of the first day. Samples usually shrink to less than original length within a few days. After two years of immersion shrinkage is 0.2 per cent or more.

(2) XX grade of paper-base laminated phenolic swells about 0.7 to 0.8 percent in length during the first year of immersion in boiling water. This value is approached rapidly, being nearly attained after the first four days. Chopped fabric-base molded phenolic behaves similarly, although the total increase in length is about one-half that of XX laminated.

(3) Molded phenolics swell rapidly in boiling water during the first week of immersion, then with decreasing speed, but progressively, for several months. Maximum values may be nearly reached after four months. Extent of swelling is, in part, a function of the filler. Ordinary electrical grades of molded phenolic increase in length from 1–2 percent in four months, while a molded phenolic bearing a high schist mica content swells about 0.4 percent.

(4) Cold-molded phenolics at first increase in length slightly during the first one to seven days, then progressively decrease to show a shrinkage of 0.5 percent or more after two years of immersion in boiling water.

(5) In boiling water no significant difference exists between the swelling of samples of molded phenolic of a given type prepared by curing in the mold for periods ranging from four minutes to one-half hour, nor is there any apparent difference between samples of the same plastic depending upon the presence or absence of a molded polish on the surface.

(6) Although polystyrene, copolymerized vinyl chloride-acetate and hard rubber show excellent dimensional stability in cold water, all three of these types of plastics are seriously affected by boiling water. Test pieces of each of these materials were somewhat warped after continued exposure to boiling water, as would be expected because of their lack of heat resistance, but other effects could be observed in spite of the obvious fact that the measurements reported are inaccurate because of such warpage.

In the case of polystyrene, shrinkage occurred progressively from the start, most rapidly at the beginning. Other samples of polystyrene, for which results are not tabulated, revealed the same effect, shrinking a little more than 1 percent after eight weeks, largely within the first day, even though they were heat-treated before immersion for eighteen hours at 110 deg. C. or 170 deg. C., depending on the sample.

Table II. Longitudinal Swelling of Certain Plastics in Water at Room Temperature

(Specimens were dried for 1 hour at 105° C. immediately prior to immersion in water.)

Type No.[a]	Type of Plastic	Longitudinal Swelling Upon Immersion in Water at Room Temperature, % After 6 Weeks	After 2 Years
	Laminated Phenolics		
1	Fabric base. Grade C	0.42	....
2	Fabric base. Grade C	0.37	0.20
3	Fabric base. Grade C. Graphite filled	0.53	0.49
4	Fabric base. Special for marine service	0.50	....
5	Fabric base. Grade L	0.50	....
6	Paper base. Grade XX	0.72	0.77
7	Impregnated wood veneer base[b]	0.39	0.45
	Molded Phenolics		
9	Good heat resistance and low water absorption for electrical applications	0.61	0.48
10	Special for low water absorption	0.37	0.58
11	High heat and arc resistance	0.22	0.48
12	Acid resistant for rayon equipment	0.50	0.74
14	Acid resistant for rayon equipment	0.34	0.69
15	Mica filled	0.06	0.22
16	100% resin; no filler	0.07	0.30
17	100% resin; no filler	0.09	0.65
	Miscellaneous		
24	Cashew nut shell oil—formaldehyde cast resin	0.54	2.29
25	Polystyrene. Molded	−0.01	−0.06
26	Vinyl chloride-acetate copolymer	0.05	....
27	Hard rubber[b]	0.05	0.23
28	Hard rubber	0.06	0.20
29	Hard rubber[b]	0.03	0.19

[a] A type number is assigned each commercial product tested for convenience in comparing results in all of the tables. Products bearing the same type number were all supplied by the same manufacturer under the same trade designation.

[b] Samples thus indicated measured approximately 1/2 by 2 1/4 by 1/2 in.

In the case of copolymerized vinyl chloride and vinyl acetate, decomposition was apparent from the start. After one month of immersion, the samples were unrecognizable. This behavior in boiling water stands in marked contrast to that in water at room temperature, under which latter condition dimensional stability of this material is excellent.

The behavior of unfilled hard rubber is curious in that, although its dimensional stability in water at room temperature is good, in boiling water it swells progressively and, in some instances, appears to be still growing in length after two years of immersion, at which time the amount of swelling is far in excess of that shown by any of the phenolics examined.

Comparison of longitudinal swelling of plastics in cold and boiling water

In order to obtain a comparison between the behavior of plastics in boiling water and in water at room temperature, samples of many of the same commercial products reported in Table I were immersed in water at room temperature after drying at 105 deg. C. for an hour,

TABLE III. WEIGHT INCREASE OF CERTAIN PLASTICS UPON IMMERSION IN HOT AND COLD WATER

Type No.[a]	Type of Plastic	% Loss in Weight[c] Upon Drying 1 Hour at 105° C.	% Increase in Weight[d] Upon Immersion in Boiling Water After 4 Days	After 2 Yrs.	% Increase in Weight[d] Upon Immersion in Water at Room Temperature After 2 Yrs.
	Laminated Phenolics				
1	Fabric base. Grade C	1.02	6.15	3.94	...
2	Fabric base. Grade C	0.87	4.67	1.80	5.29
3	Fabric base. Grade C. Graphite filled	0.86	5.11	3.85	5.83
4	Fabric base. Special for marine service	0.41	3.87	2.69	...
5	Fabric base Grade L	1.07	5.28	3.43	...
6	Paper base. Grade XX	0.32	6.38	4.22	7.11
7	Impregnated wood veneer base[b]	1.58	42.8	2.02[e]	31.53
	Molded Phenolics				
8	Chopped fabric filled	0.60	4.19	3.54	...
9	Good heat resistance and low water absorption for electrical applications	0.40	3.19	4.80	4.78
10	Special for low water absorption	0.30	2.55	4.12	3.79
11	High heat and arc resistance	0.20	1.61	5.68	2.44
12	Acid resistant for rayon equipment. 4 min. cure	0.72	3.12	4.30	4.57
13	Same as type No. 12. 1/2 hr. cure	0.30	1.76	3.28	...
14	Acid resistant for rayon equipment	0.20	1.99	4.56	3.84
15	Mica filled	0.06	1.34	1.71	1.48
16	100% resin; no filler	0.09	0.81	3.62	1.74
17	100% resin; no filler	0.06	2.94	5.02	2.92
18	Approximately 100% resin. 4 min. cure. Sanded surface	0.46	2.52	5.12	...
19	Same as type No. 18. 4 min. cure. Mold polished surface	0.33	1.97	4.79	...
20	Same as type No. 18. 15 min. cure. Sanded surface	0.48	2.55	4.58	...
21	Same as type No. 18. 1/2 hr. cure. Sanded surface	0.54	3.31	5.36	...
	Other Phenolics				
22	Cold-molded. Asbestos filled	0.57	4.90	2.01	...
	Miscellaneous				
24	Cashew nut shell oil—formaldehyde resin	0.52	5.55	0.45	8.89
25	Polystyrene. Molded	0.00	0.28	0.68	0.07
26	Vinyl chloride-acetate copolymer	0.02	12.73	....	0.70
27	Hard rubber[b]	0.08	2.94	43.3	1.17
28	Hard rubber	0.05	1.75	24.3	1.13
29	Hard rubber[b]	0.06	2.03	22.6	1.08

[a] A type number is assigned each commercial product tested for convenience in comparing results in all of the tables. Products bearing the same type number were all supplied by the same manufacturer under the same trade designation.
[b] Samples thus indicated measured approximately 1/2 by 2 3/4 by 1/8 in.
[c] Based on weight as received.
[d] Based on dry weight.
[e] Decrease in weight upon long boiling is due to erosion of the sample.

as before. Results of measurements on samples, listed in Table II, indicate the following relevant generalities.

(1) After six weeks in cold water, the longitudinal increase of C grade phenolic laminated is two to three times that of the same material after one day in boiling water. Although the amount of swelling upon prolonged immersion decreases from this high value, it does not become negative, as in the case of boiling water, even after two years.

(2) After six weeks of immersion in cold water, the samples of XX grade phenolic laminated showed about the same degree of longitudinal swelling (0.7 percent) as they did after two years longer under the same conditions (0.8 percent). Moreover, this value indicates that equilibrium has been reached, for the same increase was found after four days of immersion in boiling water and remained approximately constant during the next two years.

(3) The extent to which the swelling of molded phenolics in water at room temperature may approach that of the same materials in boiling water is apparently dependent largely upon the nature of the filler. In most instances, swelling in cold water after two years was considerably less than in hot water. In the case of the special grades of material used in manufacture of equipment for the rayon industry, however, approximately the same values were found in both cold and hot water after two years.

(4) Polystyrene gave no change in length after six weeks in water at room temperature, but shrank about 0.1 percent after two years. Vinyl chloride-acetate copolymer showed practically no change after six weeks, increasing in length only about 0.05 percent. Unfilled hard rubber increased about 0.2 percent after two years in water at room temperature. The relatively good dimensional stability of these three materials in cold water stands in marked contrast to their behavior upon immersion in boiling water. (*Please turn to page 86*)

Fiberglas–plastic combinations

by TYLER STEWART ROGERS*

IN the production and use of Fiberglas, organic plastics now play an important role. The future seems to hold unlimited possibilities for further association; indeed, the further progress of Fiberglas in some applications already awaits the development of new plastics, organic or inorganic, that will have properties not yet found in available commercial low-cost material.

To make these points clear, it is necessary to define the new material itself. The term, Fiberglas, is the trade name of glass in any fibrous or filament form made by Owens-Corning Fiberglas Corp. There are several basic forms, all made from true glass formulated of specially selected silica sand, limestone and other mineral ingredients. The glass composition itself is subject to precise control; one glass is designed for superior electrical properties, another for chemical resistance, another for thermal insulation uses, etc.

Three processes are used to convert these molten glasses into fibers. The first produces thermal insulating wools in which the fiber diameters range from about .00035 in. to perhaps .0007 in., and air filter fibers of much coarser size, ranging from .005 in. to .010. in. in diameter. These fibers are produced in great quantities from large "tanks" or glass melting furnaces, some holding 60 tons of glass at a time.

The second produces "continuous filaments," usually about .00022 in. in diameter (about $^1/_{15}$ the diameter of human hair), and of indefinite length. These fibers, gathered in strands comprising 100 to 200 filaments, form the basis for "continuous filament" yarns which are subsequently woven, braided or otherwise processed on standard textile machinery into threads, tying cords, tapes, sleevings and cloths. (Fig. 1-2.)

The third produces a "staple fiber" used for textile applications. The fiber size follows that of continuous filament, but the fiber length (averaging around 9 in. or more) resembles that of very long staple cotton or wool. Staple fiber is processed like cotton or worsted. Continuous filaments are processed like silk or rayon.

Each type of fiber lends itself to many different applications. Only those involving present or potential use of plastics can be reviewed here.

Fiberglas insulating wool is a highly resilient material having a "natural" density, as formed, of $1^1/_2$ lb. per cu. ft. Contrary to the behavior of less resilient mineral wools (the density of which is usually much higher, due to unfiberized material and less resilient fibers) the thermal resistance of the material is improved somewhat by compressing the wool to higher densities. For some applications, densities of 4, 6 or even up to 12 or 14 lb. per cu. ft. are wanted.

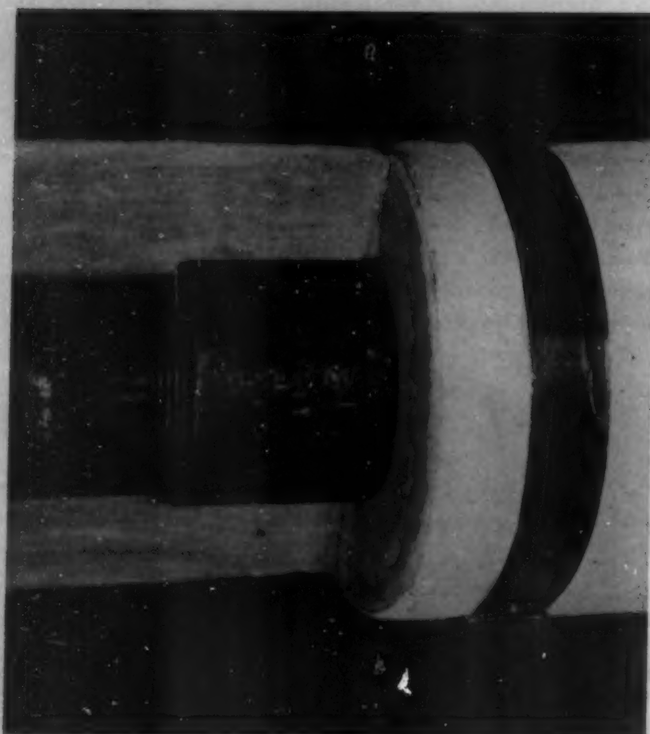
To provide Fiberglas insulation of predetermined density and dimensions, phenol-formaldehyde resin is sprayed onto the glass fibers in relatively small quantities (1.5 to perhaps 4 percent by weight, depending on the product to be formed) and then the wool is formed or compressed while under heat that sets the resin. This product, designated as PF (Permanent Form) or Type TW-PF, is used to insulate houses, ships, railroad cars, buses, trucks, domestic refrigerators, (Fig. 5) cold rooms, and for various of industrial insulation applications at temperature ranges from sub-zero to about 600 deg. F. This upper temperature limit is imposed by the binding agent; the glass fibers alone,

* Technical Director, Owens-Corning Fiberglas Corp.

1—Molten glass converted into fibers can be drawn into a continuous strand. Individual filaments are wound on a swiftly revolving spool. **2**—Fiberglas electrical cloths, continuous filament and staple fiber are processed as varnished cambric shown in tape roll (right). Small sheets are laminated fiberglas and large sections are sheets combined with mica

1

2



3—Fiberglas insulation material enters treating oven where plastic is set. 4—Cut-away section shows application of phenolic resin-bonded-glass fibers formed into an insulating molded pipe covering

as in the untreated Type TW-F, will withstand 900 to 1000 deg. F. The same combination of materials is also used to form pipe insulation (molded on mandrels) suitable for the same temperature ranges. (Fig. 5.)

Here is an application that challenges the plastics industry to produce a binding agent having higher temperature tolerances—up to 1000 deg. F. is possible. The phenol-formaldehyde resin sublimes between 450 and 600 deg. F. and thus leaves the hot face of the insulation in its virgin white, highly resilient state. The cool face, and the enclosing material used in application, must be depended upon to retain the insulation in place. A low-cost resin that is incombustible, stable when set; odorless, moisture-resistant, easy to apply, cure, and of high temperature resistance is sought.

Another important field of use for the glass-fiber material is as an electrical insulation material. Here yarns and fabrics are employed. The yarns are used as wire covering on magnet wires, and as an outer braided cover on various high and low tension cables. These wires in turn are widely used to wind motors, generators, transformers, reactors, etc., which also employ tapes, braided sleevings, varnished cloths and various forms of laminated Fiberglas to provide complete Class B (inorganic) insulation.

One laminated form is called Fiberglas-mica combination. It uses thin Fiberglas cloths on one or both sides of mica sheets or flakes, to give the mica tensile strength and pliability without loss of its electrical properties and heat resistance. Here resins or varnishes form the bond between the materials.

"Fiberglas-laminated" is the term used to define rigid sheet materials used for slot sticks or wedges in motor windings, and as a "panel" material. For these products Fiberglas cloths are bonded with phenolic resins.

In cable applications Fiberglas is used in various forms. Rovings of staple fibers may be employed for cable fillings where bulk is desired; varnished and impregnated tapes are used for thin or thick wrappings and sheathings, and yarns for thin build-ups and for braided coverings.

In all electrical applications Fiberglas can tolerate temperatures greatly in excess of those that are practical for the necessary varnishes and impregnants. The dramatic increase in the use of Fiberglas electrical insulations in the past three years is due largely to the fact that varnishes and impregnants exist which withstand temperatures above those safe for cotton, silk and similar organic insulations, and Fiberglas has given these varnishes a chance to utilize their properties to the limit. With this combination, motors, generators, transformers and similar electro-magnetic devices have been given vastly increased stamina and overload capacity—increases in the order of 400 percent greater safety factor over designed rating. By utilizing the higher temperatures that the combination of high-temperature varnishes and Fiberglas permit, motors have been built on smaller frame sizes to deliver the same rated power output. These smaller units show double the safety factor of Class A insulations and yet save weight, space and often cost. Maintenance and repair expenses also drop sharply. One company reported a saving of $24,000 annually in motor maintenance expense by converting existing equipment to Fiberglas insulation when burned-out motors needed rewinding, and by standardizing on Fiberglas insulated motors for all new equipment.

Here again is a challenge to the plastics industry. Varnishes and impregnants of still greater heat resistance than any in commercial use today are wanted. Only when such resins are found can full temperature tolerance of glass fibers be utilized in the electrical field.

Still another brotherhood of interest exists in the aircraft industry. A light plane having wings covered with Fiberglas cloth is now (*Please turn to page 96*)

Plastics statistics for 1940

THE United States Tariff Commission's preliminary statistics of production and sales in the United States of synthetic organic chemicals in1940 show that the total sales of synthetic organic chemicals were valued at $484,000,000. This is an increase of 26 percent over the 1939 sales which were higher than in any previous year. Sales of synthetic coal-tar chemicals increased from $185,000,000 in 1939 to $218,000,000 in 1940, or 18 percent, and non-coal-tar chemicals from $200,000,000 to $266,000,000, or 33 percent. The groups that advanced most in sales value were coal-tar resins, medicinals and intermediates.

The peak activity in both sales and production in 1940 was due largely to improved business, some of which was caused by increased civilian consumption and some indirectly by demands for military purposes. Production for strictly military uses, however, did not constitute a substantial portion of the 1940 output of synthetic organic chemicals. Other factors influencing production were the building up of inventories by both consumers and producers and an increase in exports together with a decrease in imports of organic chemicals.

Statistics on resins are of particular interest because of the emphasis on resins and plastic materials in national defense. The total production of coal-tar resins in 1940 reached 223,000,000 pounds, or 24 percent more than was produced in 1939; non-coal-tar resin production was 54,000,000 pounds, or 60 percent over the 1939 output, the highest previous output of resins on record. Of the alkyd resins, maleic anhydride resins increased slightly in output, and phthalic anhydride resins increased from 70,000,000 pounds to 91,000,000, or about 30 percent. There was a decline in the output of phenolic resins for casting from 8,500,000 pounds to 6,950,000, or about 18 percent. Phenolic resins for molding, however, increased from 19,000,000 pounds to 26,000,000, or 36 percent. The output of urea resins increased from 16,600,000 pounds to 21,500,000 pounds (30 percent), with a slight increase in unit value. The complete data for 1940 and the comparative totals for the three preceding years are given in Table 1.

The production of 806,000,000 pounds of coal-tar intermediates in 1940 was 33 percent greater than in 1939. Sales increased even more. Production of phthalic anhydride and phthalic acid increased nearly 31 percent; that of phenol increased 40 percent, 72,000,000 pounds being produced synthetically from benzene and 24,000,000 pounds by distillation from coal-tar crudes. The output of maleic acid and anhydride in 1940 reached about 4,500,000 pounds, or more than double that of the preceding year. Statistics on the production and sales of plasticizers during 1940 are presented in Table 2.

The synthetic organic chemical industry employed 2,692 technically trained workers in 1940 at an average salary of $2,979. The gross cost of research was $17,500,000 and the net cost $16,200,000 or 3.3 percent of the sales of all organic chemicals in 1939.

Statistics of the Bureau of the Census for the production of cellulose plastics during 1940 are recorded in Table 3. The total output reached a new high, but did not show as impressive a gain (5 percent) as that of the synthetic resin group (30 percent). The production of cellulose nitrate plastic was down about 11 percent below the 1939 level. Sheet, rod and tube manufacture from cellulose acetate was also off about 3 per-

Table 1.—United States Production and Sales of Certain Synthetic Resins in 1940

	Production	Sales		
	Pounds	Pounds	Value	Unit Value
(A) Resins derived from coal-tar: Total	222,943,118	153,520,805	$33,378,406	$0.22
Alkyd resins: Total	97,923,078			
Maleic anhydride	6,476,883	5,418,875	1,008,835	.19
Phthalic anhydride	91,446,195	42,400,005	7,774,730	.18
Coumarone and indene	24,131,733	22,976,705	1,576,907	.07
Derived from tar acids: Total	93,433,200			
Cresols or cresylic acid	11,978,763			
Phenol:				
For casting	6,953,103	6,696,008	3,175,589	.47
For molding	26,417,693	25,117,472	7,869,678	.31
For other uses	26,957,636	24,234,563	4,822,729	.20
Phenols and cresols	21,126,005			
(B) Resins from non-coal-tar sources: Total	53,871,245	47,578,845	25,989,933	.55
Urea	21,491,653	19,300,685	7,445,483	.39
Total for resins 1940	276,814,363	201,099,650	59,368,339	.30
Total for resins 1939	213,027,548	163,296,637	39,011,486	.24
Total for resins reported[1] 1938	130,358,652	101,828,188	22,871,974	.22
Total for resins reported[1] 1937	162,104,713	127,175,452	25,845,164	.20

[1] Does not include resins from adipic acid, coumarone and indene, hydrocarbons, styrene, succinic acid, and sulfonamides.

cent, probably due to a further decline in its use for making laminated glass, but the cellulose acetate molding powder showed a sufficient spurt (28 percent) to produce a net gain for the cellulosic group as a whole. Production data for ethylcellulose plastics and cellulose acetate butyrate plastics have not been made available.

Comparative data for the production of synthetic resins and cellulose plastics in the United States for the years prior to 1937 will be found in MODERN PLASTICS for October 1937, page 6, and October 1938, page 11.

Table 2.—United States Production and Sales of Plasticizers in 1940

	Production Pounds	Sales		
		Pounds	Value	Unit Value
(A) Plasticizers from coal-tar sources: Total	28,386,357	21,418,155	$4,530,095	$0.21
Phthalates: Total	18,727,424	12,765,297	2,532,705	.20
Dibutyl	8,799,528	5,506,098	947,658	.17
Diethyl	2,306,063	1,869,683	333,167	.18
(B) Plasticizers from non-coal-tar sources: Total	8,474,052	6,880,775	2,483,484	.36
Dibutyl tartrate	28,318	26,976	10,305	.38
Total for plasticizers, 1940	36,860,409	28,298,930	7,013,579	.25
Total for plasticizers, 1939	29,870,759	24,369,075	5,763,427	.24

Table 3.—Cellulose Plastic Products

These statistics on production of cellulose plastic products were released by Director William Lane Austin, Bureau of the Census, Department of Commerce. The data for sheets, rods, and tubes were reported by 10 manufacturers. The data for cellulose acetate molding composition were reported by 8 manufacturers for the months of 1940, 7 manufacturers for January 1939, 8 manufacturers for February to December 1939, and 6 manufacturers for the year 1938. The data represent practically the entire industry.[1]

Year and Month	Cellulose Nitrate				Cellulose Acetate			Total Production of Cellulose Plastics
	Production of Sheets	Production of Rods	Production of Tubes	Total Production	Production of Sheets, Rods, and Tubes[3]	Production of Molding Compositions	Total Production	
1940	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
January	878,316	291,806	68,702	1,238,824	857,277	1,176,726	2,034,003	3,272,827
February	723,107	246,298	46,797	1,016,202	636,834	971,892	1,608,726	2,624,928
March	789,307	231,297	69,036	1,089,640	550,138	1,103,977	1,654,115	2,743,755
April	532,327	245,078	74,649	852,054	558,358	950,717	1,509,075	2,361,129
May	544,352	188,938	67,056	800,346	702,385	893,374	1,595,759	2,396,105
June	535,226	169,922	64,756	769,904	633,808	870,562	1,504,370	2,274,274
July	680,067	156,643	62,413	899,123	564,729	896,860	1,461,589	2,360,712
August	610,141	208,565	71,455	890,161	772,928	1,422,938	2,195,866	3,086,027
September	736,372	256,678	100,236	1,093,286	826,248	1,708,803	2,535,051	3,628,337
October	748,779	248,384	99,236	1,096,399	983,292	1,925,720	2,909,012	4,005,411
November	661,258	306,670	92,766	1,060,694	934,006	1,606,095	2,540,101	3,600,795
December	715,240	302,198	91,219	1,108,657	867,234	1,435,149	2,302,383	3,411,040
Total 1940	8,154,492	2,852,477	908,321	11,915,290	8,887,237	14,962,813	23,850,050	35,765,340
Total 1939	9,551,548	3,001,397	820,227	13,373,172	9,140,907	11,654,928	20,795,835	34,169,007
Total 1938	6,616,787	2,237,395	633,744	9,487,926	6,830,506	7,394,291	14,224,797	23,712,723
Total 1937	13,582,778	3,157,525	982,006	17,722,309	13,235,062	(2)	(2)	(2)
1941								
January	719,336	349,402	97,794	1,166,532	616,525	1,631,502	2,248,027	3,414,559
February	720,173	314,560	97,399	1,132,132	343,605	1,878,807	2,222,412	3,354,544
March	844,819	363,429	99,345	1,307,593	464,601	2,231,630	2,696,231	4,003,824
April	927,399	356,179	136,048	1,419,626	402,492	2,254,895	2,657,387	4,077,013
Total 4 mos. 1941	3,211,727	1,383,570	430,586	5,025,883	1,827,223	7,996,834	9,824,057	14,849,940
Total 4 mos. 1940	2,923,057	1,014,479	259,184	4,196,720	2,602,607	4,203,312	6,805,919	11,002,639
Total 4 mos. 1939	3,073,128	1,069,131	261,838	4,404,097	3,470,665	3,295,755	6,766,420	11,170,517

[1] Ed. Note: Taking 80c per lb. as an estimated unit value for cellulose plastics, their total production in 1940 may be valued at $28,600,000.

[2] Molding compositions not called for on schedule for 1937.

[3] Beginning with February 1941, data does not include production of cellulose acetate safety glass sheets.

Plastics digest

This digest includes each month the more important articles (wherever published) which are of interest to those who make plastics materials or use them. Requests for periodicals mentioned should be directed to the individual publishers.

General

HOW MUCH CAN PLASTICS PRODUCTION BE EXPANDED? H. M. Batters and James A. Lee. Chem. and Met. Eng. *48*, 128–31 (May 1941). A survey of the production facilities for the chemicals required in the manufacture of plastics indicates sufficient supplies of some but not all raw materials required by the industry. The chemicals considered include phenol, cresols and cresylic acid, formaldehyde, urea, methanol, acetic acid and anhydride, cotton linters, nitric acid, phthalic anhydride, naphthalene, glycerol, and acetone. Cf. also MODERN PLASTICS, June 1941, page 92.

SOME CORROSION TESTS IN A RAILWAY TUNNEL. S. C. Britton. British Plastics *12*, 380, 390 (May 1941). Non-ferrous metals and alloys, mild steel protected by paints, by metal coats, and by thick wrappings, cast iron, stainless steels, and a few non-metallic materials were exposed in the ventilating shaft of a steam-operated railway tunnel for 3¼ years. A molded phenolic-fabric pulley was the only specimen to remain substantially unchanged at the conclusion of the test.

PLASTICS. H. V. Potter. Chem. and Ind. (London) *60*, 153–7 (Mar. 8, 1941). A review of applications of plastics.

SOLVENTS FOR ADHESIVES. R. K. Strong and K. Tator. Chem. Industries *48*, 330–3 (Mar. 1941). Three general mechanisms by which cementing of surfaces is accomplished are tackiness of adhesive base, chemical reaction, and evaporation of a volatile medium. Particular solvents employed for various adhesives are listed and their functions discussed.

Materials and Manufacture

CAST PHENOLICS. Product Eng. *12*, 309–12 (June 1941). Design data and fabrication cost analysis for cast phenolic plastics are included in this survey. Molding of cast resins is done in three types of molds: straight draw, split, and cored. These as well as finishing and assembling methods are described.

SHELLAC RESEARCH LITERATURE. London Shellac Research Bureau Publication, March 1941. Abstracts covering articles about shellac products published during the year 1940 are assembled in this pamphlet.

DEVELOPMENT OF POLYVINYL RESINS. G. O. Morrison. Chem. and Ind. *60*, 209 (Mar. 29, 1941). The constitution and applications of polyvinyl acetates, alcohols, and acetals are reviewed.

Applications

LAMINATED PLASTICS IN THE PLATING INDUSTRY. F. I. Bennett. Metal Finishing *39*, 238–40 (May 1941). Uses of laminated plastics in the plating field include plating rack covers, insulators, and supports, plating barrels, baffles, baskets, splash shields, and plating masks. The necessity of consulting the supplier regarding the proper grade of laminated plastic for such applications is emphasized.

PLASTICS IN AIRCRAFT. J. E. Simonds. Aviation *40*, 38–9, 124+ (May 1941). The construction of propellers, interior parts, and structural members of aircraft from plastics is discussed.

MOLDING PLASTICS. R. Decat. Aviation *40*, 39–41, 126+ (May 1941). Methods used in molding airplane structures and accessories are described. Developments by 10 different companies in this field are reviewed.

STRUCTURAL APPLICATIONS OF PLYWOOD. Keith Rider. Aero Digest *38*, 144, 146, 148 (June 1941). A general discussion of the use of resin-bonded plywood in the construction of fuselages, wings, stabilizers, and fins of aircraft.

PLYWOOD. Plastics 5, 89–92, 94–7, 100–1 (May 1941). The manufacture of flat-pressed plywood is described. Details of some of the methods which American aircraft firms are employing to mold plastic-plywood structures are discussed and illustrated. The types of urea-formaldehyde adhesives used in plywood manufacture and the operating conditions for these glues are surveyed.

SYNTHETIC RESINS AS EXCHANGE ADSORBENTS. R. J. Myers, J. W. Eastes, and F. J. Myers. Ind. and Eng. Chem. *33*, 697–706 (June 1941). See abstract in MODERN PLASTICS *18*, 76 (May 1941).

ALL-AMERICA PACKAGE COMPETITION AWARDS. Modern Packaging *14*, 119–241 (Mar. 1941). Awards for developments in 1940 included transparent, luminous, and molded plastic containers.

Properties and Testing

ACCELERATED TESTING. C. G. Ollinger. Paint, Oil and Chem. Rev. *103*, 9–12+ (Mar. 13, 1941). Average number of hours of sunshine at various locations in the United States are shown graphically. Spectral energy distribution curves are given for sunlight and various carbon arcs. Accelerated weathering equipment is described and illustrated.

CHEMICAL RESISTANCE OF PLASTICS. W. Buchmann. Kunststoffe *30*, 357–65 (Dec. 1940). The resistance of polyvinyl chloride to various reagents is used to illustrate the procedure to be followed in conducting such tests. Acids, alkalies, salt solution, gases, organic solvents, and water were placed in contact with the plastic at various temperatures and concentrations.

A SIMPLE PHOTOELECTRIC TURBIDIMETER. S. Silverman. Rev. Sci. Instruments *12*, 77–8 (Feb. 1941). An apparatus is described for measuring haze in colloidal or turbid solutions or masses.

STRENGTH AND THINNESS OF ADHESIVE JOINTS. J. J. Bikerman. J. Soc. Chem. Ind. *60*, 23–4 (Jan. 1941). Thin joints are stronger than thick ones. Two-thirds of the difference observed can be accounted for by the higher probability of a weak spot in a thicker specimen. Hence the rules, "the thinner the film, the stronger the joint" and "the shorter the fiber, the higher the strength," are closely related. "Molecular forces" are presumed to be of minor importance in adhesion.

SOLVENTS AND THE STRUCTURES OF CELLULOSIC SHEETS. J. Spence. J. Phys. Chem. *45*, 401–10 (Mar. 1941). Sheet materials are formed by the reorganization of long-chain molecules or their aggregates on removal of the dispersion medium. The effects of various solvents on the properties of films prepared from solutions of cellulose acetate, triacetate, acetate-propionate, and acetate-butyrate were studied. Sheets which show high negative birefringence and high crystallinity in the x-ray diffraction diagram are invariably the most brittle. Polar solvents, such as ethylene chlorohydrin, methyl formate, and acetone, give such manifestations. It is concluded that solvent influence determines the degree of crystallite organization and hence the flexibility of the films. Highly organized crystalline sheets do not show the same reaction to plasticizer content as do those possessing the smaller crystallite regions.

U. S. plastics patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each

CONTACT LENS. L. L. Gagnon and H. R. Moulton (to American Optical Co.). U. S. 2,240,157, April 29. Molding methyl methacrylate resin lenses from impressions taken in direct contact with the wearer's eyeball, so that an exact instead of an approximate fit is obtained.

PLASTIC JEWELRY. H. E. Krieke (to Melvin A. Reich). U. S. 2,240,247, April 29. Fitting a plastic gem into a metal support bearing an appropriate design.

GASKET SEAL. S. M. Lillis (to Victor Mfg. and Gasket Co.). U. S. 2,240,263, April 29. A metal-covered asbestos gasket is sealed by covering the metal with an inner film of resin-plasticized nitrocellulose and an outer film of cellulose acetate.

UREA RESIN. W. Scheik (to Bakelite G. m. b. H.). U. S. 2,240,271, April 29. Molding a mixture of urea and a solid formaldehyde polymer in presence or absence of a phenol-aldehyde resin.

FRICTION DISK. G. Walters (to Russell Mfg. Co.). U. S. 2,240,358, April 29. Impregnating a flattened tube of loosely interwoven strands with a thermosetting binder and winding the material spirally and molding it into a unitary disk.

MOLDING COMPOSITION. E. R. Dillehay (to Richardson Co.). U. S. 2,240,480, May 6. Making a heavy duty shape-retaining fiber-reinforced molding composition from a water-soluble resin varnish and an alcohol solution of a resin.

PLASTER. G. C. Tyce and V. Lefebure (to Imperial Chemical Industries Ltd.). U. S. 2,240,529, May 6. Adding a sirup of cold-hardening synthetic resin to anhydrite plasters to produce a plaster which can be cast, molded, sawed, turned or otherwise mechanically worked.

RUBBER-LIKE POLYMER. W. J. Sparks (to Standard Oil Development Co.). U. S. 2,240,582, May 6. Stabilizing tough rubber-like iso-olefin polymers against photochemical deterioration by adding a small proportion of a phenolic resin.

POLYMERIZER. Jas. C. Harris, Jr., and Geo. Sutherland. U. S. 2,240,618, May 6. A closed kettle for making resinous polymers in an inert gas atmosphere is fitted with means for removing volatile reaction products.

DECORATING PLASTICS. C. A. Bauer (to Cardinal Corp.). U. S. 2,240,900. May 6. Transparent shaped articles having a recess in the rear face are decorated by forming a design in low relief in the recess and applying roll leaf having a colored coating.

LINOLEUM BINDER. A. B. Miller (to Hercules Powder Co.). U. S. 2,240,939, May 6. Heating a pine resin with a drying oil and condensing the product with an aldehyde till it acquires an elastic gel structure.

MOLDING DEVICE. Emile G. L. Girard. U. S. 2,241,125, May 6. A mold core having an elastic tube with a wire coil embedded in its wall in such a way that the coil and the tube have the same coefficient of diameter decrease when the tube is stretched.

DIPPED ARTICLES. A. Boecler and K. Bratring (to Neocell Products Corp.). U. S. 2,241,176–7, May 6. A machine for making hollow articles by dipping molds in a solution of a plastic has separate chambers adapted to prevent formation of dangerous air and solvent vapor mixtures.

PLASTIC INLAYS. J. P. Burke (assignor of one-half to F. L. McLaughlin). U. S. 2,241,180, May 6. Making decorative plastic inlays by an injection molding method.

RESIN FILMS. R. H. Talbot (to Eastman Kodak Co.). U. S. 2,241,225, May 6. Casting a synthetic resin film, stripping it from its support, dipping in cold water to cure the film and relieve internal strains, then dipping in warm water and finally again in cold water.

UNSATURATED CELLULOSE ESTERS. C. J. Malm and G. D. Hiatt (to Eastman Kodak Co.). U. S. 2,241,226, May 6. Esterifying cellulose with long chain unsaturated acids in an oxygen-free atmosphere and drying the ester under nonoxidizing conditions.

ACETAL RESIN. G. B. Bachman (to Eastman Kodak Co.). U. S. 2,241,234, May 6. A partial polyvinyl acetal resin containing not more than 15 percent of unreacted polyvinyl alcohol and not more than 5 percent of unhydrolyzed polyvinyl acetate.

COLORED PLASTICS. E. M. Franklin (to Eastman Kodak Co.). U. S. 2,241,251, May 6. Hot milling a cellulose ester with a plasticizer and a colored pigment to form a color concentrate which is then used to color molding compositions.

MUSICAL STRINGS. Lewis E. Wackerle. U. S. 2,241,-282–3, May 6. Musical string comprising a wire encased in a thermosetting phenolic resin and wrapped with metal tape, the resin serving to insulate the wire and tape electrically from each other; and a method of making such musical strings.

BUILDING BOARD. W. Lüty (to Th. Goldschmidt Corp.). U. S. 2,241,312, May 6. Cementing thin plies of fibrous material to a perforated heat-conducting metal plate with a thermosetting resin cement, heating under pressure to set the resin, and cementing thick plies of fibrous material to both faces of the laminated product.

POLYAMIDE FIBERS. P. Schlack (to I. G. Farb. Akt.). U. S. 2,241,321, May 6. Heating an amino acid lactam to form a solid polymer which can be spun continuously from a melt.

CYCLIC POLYAMIDES. W. E. Hanford; C. H. Greenewalt (to E. I. du Pont de Nemours and Co.). U. S. 2,241,322–3,

(Please turn to next page)

May 6. Heating a cyclic acid amide (with at least a 7-membered ring including the amide nitrogen atom) with at least 10 mol-percent of water at temperatures between the melting and pyrolytic decomposition points to form a polyamide which can be cold drawn into oriented fibers.

PLASTICIZED RESIN. W. H. Carmody (to Neville Co.). U. S. 2,241,340, May 6. Lacquer comprising a solution of a hydrogenated coumarone-indene resin plasticized with polyisobutylene.

CELLULOSE ETHERS. C. R. Fordyce and J. G. Stampfli (to Eastman Kodak Co.). U. S. 2,241,397, May 13. Making high viscosity cellulose ethers by etherification with ethyl chloride in presence of sufficient alkali to keep the bath alkaline throughout the reaction.

OIL-SOLUBLE RESINS. Israel Rosenblum. U. S. 2,241,-422, May 13. Resins which yield nonpenetrating varnishes are made by acid condensation of a phenol with formaldehyde and a ketone in presence of rosin and dipentene or terpineol.

GRINDING WHEEL. A. W. Walker (to Carborundum Co.). U. S. 2,241,433, May 13. Segments of an abrasive disk are cemented to a rigid backing plate with polycholoroprene, the joints between segments being cemented with a cold-setting resin.

BENZYL CHLORIDE RESIN. W. J. Sparks and D. C. Field (to Standard Oil Development Co.). U. S. 2,241,488, May 13. Polymerizing benzyl chloride or other aralkyl halides with the aid of a Friedel-Crafts catalyst below 0 deg. C.

PLASTIC. W. I. Buckeridge (to Standard Oil Co. of Indiana). U. S. 2,241,538, May 13. Moldings are made from a pigmented resin and an extract obtained by extracting lubricants with 2,2′-dichloroethyl ether.

GRANULAR ETHYLCELLULOSE. E. L. Kropscott (to Dow Chemical Co.). U. S. 2,241,706, May 13. Mixing water-wet precipitated alkylcelluloses with molten wax in aqueous suspension and cooling the suspension to solidify the wax granules.

FISH LURE. Edmond E. Bates. U. S. 2,241,941, May 13. Molding hollow articles of translucent plastic in such surface form as to simulate the appearance of a fish.

SAFETY GLASS. A. Weihe and F. Herrlein (to General Aniline and Film Corp.). U. S. 2,242,019, May 13. A condensation product of polyvinyl alcohol with methylcyclohexanone, plasticized with neutral methyl diglycolate, as interlayer in safety glass.

MOLDING PRESS. V. I. Zelov and W. Strauss (to Molded Insulation Co., Inc.). U. S. 2,242,189, May 13. A press for molding plastic articles has an ejector, the operation of which is automatically stopped by the ejected article.

PHENOL-TERPENE RESIN. H. Hönel and A. Zinke (to Reichhold Chemicals, Inc.). U. S. 2,242,250, May 20. Condensing a phenol with a polyhalogenated terpene in presence of a condensing agent which eliminates hydrogen halide.

CELLULOSE DERIVATIVE POWDER. G. Schneider (to Celanese Corp. of America). U. S. 2,242,372-3, May 20. Dissolving cellulose acetate or alkylcelluloses in a solvent:nonsolvent blend under pressure, suddenly releasing the pressure, drying the resulting porous precipitate and grinding it.

STABILIZING RESIN SIRUPS. P. C. Schroy and R. P. Hofferbert (to American Cyanamid Co.). U. S. 2,242,484, May 20. Condensing urea with formaldehyde to a sirup containing about 50 percent resin, neutralizing, evaporating part of the solvent and adding alcohol to form a sirup which can be diluted without precipitation.

TRANSLUCENT SCREENS. Bernard M. Bodde, U. S. 2,242,567, May 20. Spraying multiple coats of cellulose ester solution on a horizontal matrix, and stripping off the resulting sheet.

BOX TOES. R. S. Ritchie (to Dow Chemical Co.). U. S. 2,242,729, May 20. Impregnating an absorbent fibrous base with a plasticized blend of cellulose ether and a fusible nonsetting resin.

ANTICORROSION FILM. J. E. Shields (to Alox Corp.). U. S. 2,242,837, May 20. Oxidizing mineral hydrocarbons to alcohols, ketones, neutral esters and lactones, and blending the product with a synthetic resin to produce a corrosion-resisting film-forming composition.

ABBRASIVE DISK. F. O. Albertson (to Albertson and Co., Inc.). U. S. 2,242,877, May 20. Impregnating a laminated fiber board backing with a phenolic resin and applying a layer of abrasive grains, using the same resin as binder.

MOLDED BOX. K. T. Barrett (to General Electric Co.). U. S. 2,243,065, May 27. A molded box has a pair of projections molded integrally with the wall with recesses for the hinge of the cover.

TRANSFER SHEET. J. Bjorksten and W. J. Champion (to Ditto, Inc.). U. S. 2,243,078, May 27. A transfer sheet for planographic printing is coated with a composition of soybean oil, carnauba wax and a petroleum hydrocarbon resin, impressions on the sheet being transferable by pressure without heat to a contacting sheet.

COATING FOR RUBBER. K. D. Bacon and T. A. Kauppi (to Dow Chemical Co.). U. S. 2,243,185, May 27. A composition for coating rubber surfaces contains a medium substituted ethoxyethylcellulose, an alcohol-soluble alcohol-modified thermosetting urea resin and a soft alkyd resin compatible therewith.

HEAT-CURED PLASTIC. R. R. Lewis and A. J. Weiss (to Vulcan Proofing Co.). U. S. 2,243,386, May 27. Blending 10 to 60 percent of polychloroprene and 40 to 90 percent of a hydrolyzable, thermally unstable alkyd resin to form a heat-cured solvent-resisting product.

FURFURYL ALCOHOL RESIN. J. G. Meiler (to Marathon Paper Mills Co.). U. S. 2,243,481, May 27. Condensing furfuryl alcohol with ligninsulphonic acid or a ligninsulphonate to form a resin.

INSULATED WIRE. R. W. Hall and H. A. Smith (to General Electric Co.). U. S. 2,243,560, May 27. Insulating wire with a composition of spun glass and a polyvinylal resin, derived from an aldehyde and a hydrolyzed vinyl ester.

PROTEIN PLASTIC. R. J. Myers (to Resinous Products and Chemical Co.). U. S. 2,243,644, May 27. Plasticizing a protein with a salt of a substituted aryl ether of a lower hydroxy-aliphatic acid.

Publications

Write direct to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent postpaid at the publishers' advertised prices

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British Plastics Year Book, 1941

Published by Plastics Press, Ltd., c/o Sidney Press, Ltd., Bradford, England

Price 15 / net **468 pages, indexed**

Our London letter arrived on time; informative and interesting as usual, observed that "in these days of stark realism all that is needed is the bare necessity without any frills." Obviously, then, turning out a plastics year book comes under the heading of a necessity with the British. As concise, accurate and thorough as usual, the 1941 book is divided into nine sections. There is a particularly good review of recent British patterns, "Ethenoid Resins," by Dr. C. A. Redfarn and a comprehensive piece on Cellulose Acetate; a Review of Progress Made in 1939 and 1940 as Revealed by Patent and Technical Literature, by V. E. Yarsley, D.Sc., M.Sc., F.I.C. It is an authoritative guide to the industry abroad and an asset to any plastics library. H. S.

The Progress of Science—A Review of 1940

Edited by H. H. Sheldon and S. E. Farquhar
The Grolier Society, 2 West 45th St., New York, 1941

Price $7.50 **442 pages**

The many scientific wonders of these modern times are explained in this survey of the activities of the trail blazers in the natural and social sciences. It is a book which is very informative, easy to read, most interestingly illustrated, and is super de luxe all the way through. More than 100 specialists have contributed brief accounts of outstanding developments in their fields. These topics, alphabetically arranged for ready reference and pleasant browsing, start with Aerial Surveying, and range through Aptitude Determination, Exploration, Household Science, U. S. Navy, Plastics, Public Opinion, Reclamation, and Volcanology, to Zoology. Biographies and photographs of individuals prominent in scientific news during 1940 add to the general interest and wealth of information contained in this volume. G. M. K.

A Review of Driers and Drying

by E. F. Bennett

Chemical Publishing Co., Inc., New York, 1941
Price $1.75 **90 pages**

This book is a survey of information on drying oils, the fundamental principles of the drying phenomenon, and the influence of metallic driers thereon, as worked out through many years by investigators all over the world. It is highly recommended by two well known authorities on the subject, Drs. J. S. Long and William Krumbhaar, who in extended forewords have contributed valuable analyses of the problems which still confront the research worker in this field. G. M. K.

★ *GOODBYE TO FUSES,* IS AN AMUSING AND INformative little booklet issued by Cutler-Hammer, Inc., cold molders and power electric manufacturers, Milwaukee, Wis., to acquaint the layman with recent developments in electrical lighting protection. Typical stories to illustrate the point are, "The Lesson of the Electric Toaster," and "The Case of the Additional Waffle Iron."

★ CLOVER MFG. CO., NORWALK, CONN., PRODUCERS of coated abrasives and popular clover grinding and lapping compounds, have recently published a 28-page Catalog and Price List. Facts and figures are effectively presented and the reader may easily find the information and prices he is seeking. Twelve pages are devoted to helpful engineering information.

★ A CONCISE BULLETIN (NO. 341), PUBLISHED BY Jessop Steel Co., Washington, Pa., furnishes detailed instructions on how to carburize and heat-treat molds to develop high wear resistance for long production runs. Described in the booklet is the Jessop press E-Z hobbing steel, a dead soft low carbon steel used for making molds for plastics and die castings by the hob sinking method.

★ TIPS ON SELECTION AND APPLICATION OF Micarta aircraft pulleys are given in a new four-page leaflet just announced by the Westinghouse Electric Mfg. Co., Trafford, Pa. Featured in the leaflet is a 2-page chart showing weights and dimensions of pulleys for various standard cable sizes.

★ TINIUS OLSEN TESTING MACHINE CO., 500 N. 12TH St., Philadelphia, Pa., has available in their Catalog No. 19 and Bulletin 14, a complete description of their balance testing machines. The tendency toward higher speeds in practically all industries demands that rotating parts be carefully dynamically balanced to a high degree of accuracy. The literature includes a general discussion of the principles which are involved, both static and dynamic balancing.

★ HYDROCARBON CHEMICAL AND RUBBER CO., 335 South Main Street, Akron, Ohio, has put out an attractive 4-page illustrated booklet on "*Hycar*," a new group of synthetic rubbers produced from 100 percent American products. By an exclusive polymerization process the unsaturated hydrocarbon, butadiene, is converted to synthetic rubbers that are said to have all the essential and better physical properties of natural rubbers and, in addition, many important properties which natural rubbers cannot possess.

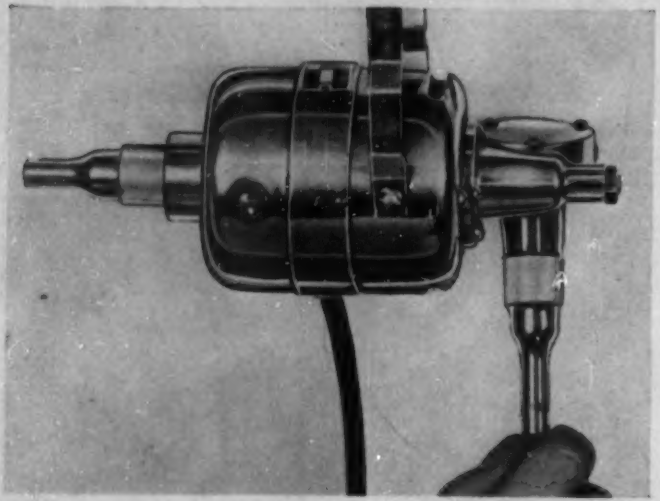
★ AN ATTRACTIVE 6-PAGE BOOKLET WITH HANDsome color plates has recently been issued by Plastics Div., of Monsanto Chemical Co., Springfield, Mass., on Vue-Pak, transparent packaging material.

★ AN ALL-COLOR CATALOG HAS RECENTLY BEEN issued by Group Trade Expansion, Inc., for exclusive distribution through merchant members of its organization. The catalog includes color photographs of merchandise that can be secured for Trade Tokens. A number of plastic items are included such as an electric iron with plastic handles; electric razor and "Airline" plastic ware. Headquarters are 51 E. 42nd St., New York.

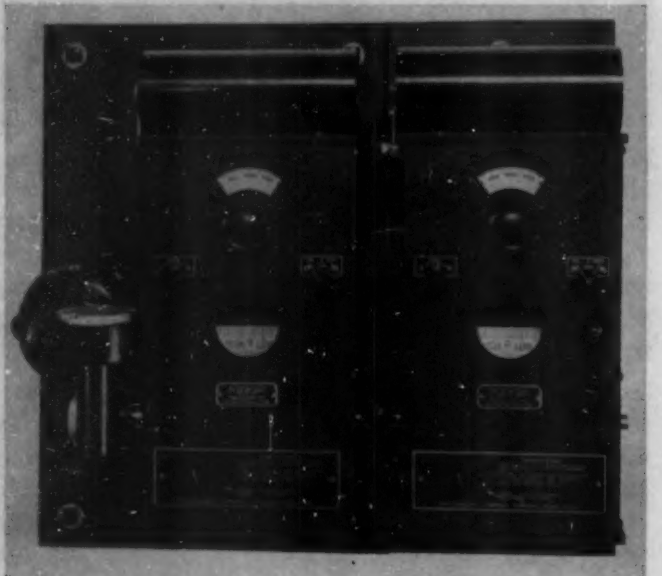
★ A NEW BOOKLET ENTITLED *THE WATER TREATment Science of Tomorrow in Today's Engineering* has recently been published by American K.A.T. Corp., New York City. The booklet explains the theory of organic colloidal action and briefly discusses the modern trend in water treatment.

★ CONTINUING A TREND TOWARD THE SIMPLIFICAtion of tool steel selection and heat treatment, initiated with the Matched Set Method of Tool Steel Selection in 1935, the Carpenter Steel Co. has issued a 96-page addition to the company's Matched Tool Steel Manual, which alphabetically thumb-indexes all types of tools and dies in general use. The various conditions each type of die or tool may meet in fabrication, heat treatment and service are analyzed and specific tool steels recommended to meet each set of possible conditions. In addition to the Quick Reference Tool Index and Steel Selector, the new Carpenter Manual retains all the material in the old, revised to accord with latest research data and tool making practice and has 159 pages.

Machinery and equipment



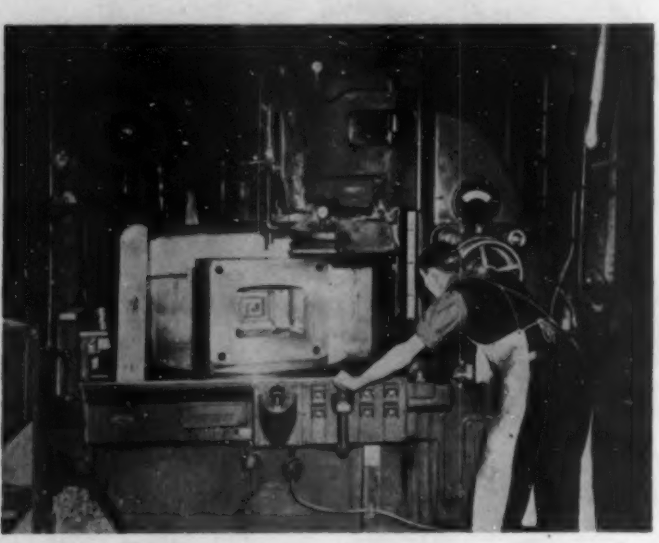
★ FOREDOM ELECTRIC CO. HAS ADDED A COMPLETE line of flexible shaft tools to its new No. 400 Series Tools. Features are a flexible shaft and hand-piece assembly that can be quickly attached to either the geared end for low speeds, or to the motor shaft direct for high speeds. A six-step foot-operated speed control is included with the tool which means that a speed range of from 500 to 14,000 rpm. is obtainable. The purchaser has the choice of five different handpieces, such as the one pictured above, some small as a pencil, but all with the quick-detachable feature which makes it possible to use exactly the right type of tool for the work at hand.



★ AUTOMATIC TEMPERATURE REGULATION FOR plastic molding is now offered by Foxboro Co. The controllers (pictured above) have a potentiometer measuring system and a detecting system that is mechanically simple and extremely dependable. Temperature changes of one or two degrees can be detected. The mercury switch contacting systems of large capacity, up to 65 amperes at 110 volts, permit electric heating systems to be connected directly to the control instrument without interposition of relays or contactors. The design provides for a number of control instruments in a group, driven by a single motor unit attached to the first instrument of the group.

★ TWO NEW UNITS IN THE MULTI-VANE LINE OF portable pneumatic drills have been put out by the Ingersoll-Rand Co. In two sizes, they weigh approximately one-half, or less, than that of the previously issued smallest unit of the line. Four units in the first size weigh $1^1/_2$ to 2 lbs., and operate at 950 rpm. for the largest and 10,000 rpm. for the smallest. Similarly, four units in the second size weigh $2^1/_4$ to $2^7/_8$ lbs., and operate at 425 to 2250 rpm. with 90 lb. air pressure. All are non-reversible.

★ AN ASSORTMENT OF 10 HIGH SPEED STEEL SLOTting tools for the Slotmaster is announced by Experimental Tool and Die Co. The slotting heads are said to be adaptable for all milling machines, providing double duty facilities and can also be used as a vertical or horizontal slotter and shaper for cutting key-ways, templates, splines, internal gears and for slotting out precision blanking dies and molds, or wherever sharp corners and special shapes are machined.



★ THIS NO. 18 BLANCHARD SURFACE GRINDER (above) is used in finishing the outside surfaces of a die 18 in. by 22 in. by 11 in. for a molded plastic radio cabinet. The die is made of S.A.E. 4615 alloy steel and has approximately $^1/_{16}$ in. metal to remove on all surfaces. The surface grinder can be used for machining flat surfaces unobstructed by projections, requiring better finish and accuracy than would result from a roughing cut—including much work that is outside the field commonly considered as surface grinding. The compact and rigid construction is claimed to give the necessary support to wheel and work and the three-point adjustable column support to provide for maintaining correct alignment. Lapping is said to be reduced. Many features, such as direct motor drive, three-point column support, one piece steel magnetic chuck, easy cleaning base are claimed to increase the accuracy, speed and ease of operation.

★ DESIGNED ESPECIALLY FOR INDUSTRIAL APPLIcations requiring smoothly adjustable speeds over wide ranges with constant torque, in locations where only a-c supply is available, a new 10-to-1 adjustable-speed drive, which uses a series circuit without the usual exciter, is announced by the Westinghouse Electric & Manufacturing Company. It is available in ratings from 1 to 15 horsepower with a standard speed range of from 175 to 1750 rpm, for 2- or 3-phase operation on 220-, 440-, 550-volts, 60-cycle systems.

In the limelight

★ IN RESPONSE TO THE MANY INQUIRIES WE HAVE received regarding the availability of vinyl resins, we report the following: The Office of Production Management has placed on the priority list at present polymerized vinyl chloride and its copolymer, with vinyl acetate—two grades containing 92 percent or more of vinyl chloride, plasticized or unplasticized. Materials will be distributed, we are told, according to priority allocations.

After that market is taken care of, other vinyl materials will probably be available to manufacturers of non-defense items as increased production comes in. An expansion program for production of vinyl resins has been under way for some time and it is expected to continue on through 1942, unless there is some unforeseen contingency.

★ IN ORDER TO PROVIDE A SUPPLY OF NEOPRENE synthetic rubber that will be adequate for all defense and commercial needs, including a substantial tonnage of certain types of heavy-duty tires, the Du Pont Co. will build a new plant at Louisville, Ky., according to an announcement from W. S. Carpenter, Jr., president. Neoprene, a non-metallic substance on the Government's mandatory priority list has been in commercial production for ten years.

★ W. W. ROWE, PRESIDENT OF THE PAPER SERVICE Co., announces that the company has changed its name to Cincinnati Industries, Inc. It will continue to operate under the same management and without change in its capital structure. Change was due to the fact that the former name did not adequately describe the business and furthermore implied a jobbing business rather than manufacturing. The organization is known for work in resin treated crepe paper—a process which permits the forming of molded objects with compound shapes, yet which has the strength of continuous laminations.

★ JOHN L. COLLYER, PRESIDENT OF THE B. F. GOODrich Co., has announced plans for the construction of a manufacturing plant for the production of Koroseal, synthetic rubber, at Bell Lane, seven miles from Louisville, Ky. The new plant is expected to quadruple the company's output. The plant will be built on a 20-acre site in 5 separate buildings with a combined floor space of 75,000 sq. ft. Increasing national defense requirements are responsible for expansion, according to Collyer.

★ W. H. FACE, MANAGER, MONSANTO CHEMICAL Co., Plastics Div. branch office at St. Louis, Mo., has been called to active service as first lieutenant of cavalry at Fort Riley, Kansas. R. E. Evans, formerly Vuepak representative in the Chicago area, will take his place.

★ DR. JOSEPH DUBOSE CLARK HAS BEEN APPOINTED Chemical Director of the Glyco Products Co., Inc., Brooklyn, N. Y., in charge of research and development, particularly in applications of the newer chemicals, resins and waxes, to the paper, rubber and coating industries.

★ PLASTICS ARE NOT THE PANACEA FOR THE ILLS of industry. H. S. Spencer of Durez Plastics and Chemicals Co., Inc., brought this point home to the Cleveland chapter of The National Association of Purchasing Agents recently in a talk on plastics. "Plastics are not at all times substitute materials," said Mr. Spencer. "They are more nearly alternate materials and, while they solve many problems, they will not solve all problems. Manufacturers contemplating change-over from other materials to plastics must realize that it is not an overnight job. Invariably it means redesign, as the physical characteristics of plastics are different from the materials that have been used."

★ THE POSITION OF THE PURCHASING AGENT IN these difficult days of national defense was discussed in its entirety by George S. Brady in his address, "Substitution Possibilities," before the National Association of Purchasing Agents," on May 26, Chicago, Ill. Mr. Brady is chief of the Substitute and Secondary Materials Section, Price Division, Office of Price Administration and Civilian Supply, Washington, D. C.

Delivery and price, Mr. Brady pointed out, concern the purchasing agent most, and it is out of the failure to have a satisfactory answer to these that he is interested more than ever before in the subject of substitutes.

"We must see," Mr. Brady stated, "that our defense industries are supplied as far as possible with the materials they are accustomed to handle in order to keep them going smoothly at high speed. But very important, too, is the fact that we want to avoid restraining orders on the public. These give the same effect in trade as buyers' strikes, and it is preferable that the changes and curtailments begin at the factory and work out to the consumer through the channels of trade."

Plastics as an aid to national defense was stressed, although, said Mr. Brady, it cannot be considered as just a substitute material, nor as one single material. An idea of the role of plastics in the war, however, can be gained, he said, from the fact that out of 600 parts studied for replacement on bombers, 82 were recommended for consideration, and 34 were actually found practicable for substitution with plastics.

"This is a high percentage," he stated, "considering the rigid specifications of bomber materials, especially where the part requires riveting or close tolerances."

In conjunction with this meeting, the Plastics Materials Manufacturers' Association presented an interesting exhibit of plastics, featuring items used to replace metals in industrial production.

★ AT A RECENT MEETING OF DIRECTORS OF THE Union Carbide and Carbon Corp. the following new officers were elected: Jesse J. Ricks, former president of the corporation, chairman of the board; Benjamin O'Shea, former vice-president, president; James A. Rafferty, vice president, elected to the board of directors to fill a vacancy caused by the resignation of Matthew J. Carney, and Robert W. White, secretary and treasurer, as well as vice-president of the company.

★ EXECUTIVES OF THE MASONITE CORPORATION announce that more than $1,500,000 is being expended for expansion and improvements of its Laurel, Miss., plant, in order to speed up production in wood fibre-board to serve the requirements of the national defense program, as well as needs of its customers. Largest single expenditure is for an $800,000 steam turbine power plant which will go into service next month. The generators will supply nearly 13,500 kilowatts of electric power. This will provide considerable relief for T.V.A., it is claimed.

★ HAROLD VAN DOREN & ASSOCIATES, TOLEDO, industrial designer, is opening a branch in Philadelphia in July, with Mr. Van Doren in charge. J. McLeod Little, chief executive assistant, has been made a partner and will take charge in Toledo.

★ STYLO-PLASTIC FOR SIGNS AND SPECIAL LETTERing, recently placed on the market by Klarion Merchandising Corp., 17 West 35th St., New York, is available in cans for lettering on glass, fabric, metal, wood or paper. The plastic compound is poured from a tube, similar to that used by pastry cooks, to make the three dimensional letters. Colors available are Chinese red, Royal blue, light green, ivory, brown, purple black and yellow. Colors harden in about 2 hours and darken but the dull lettering can be shellacked.

★ GERING PRODUCTS, INC., DEALERS IN PLASTIC scrap materials, have moved from Rahway, N. J., to North 7th St. and Monroe Ave., Kenilworth, N. J. Telephones: CRanford 6-2144 and 6-2145.

(Please turn to next page)

CLASSIFIED

WANTED: Injection Molding Acetate Scrap or Rejects in any form, including Styrene, Acrylic, Vinyl Resin Scrap materials. Submit samples and details of quantities, grades and colors for our quotation. Reply Plastics, 141 Halsey St., Newark, N. J.

WANTED: Stainless Steel or Nickel Kettle, Vacuum Pan, Hydraulic Press, Preform Machine and Mixer. Reply Box 275, Modern Plastics. No Dealers.

WANTED: PLASTICS SCRAP OR REJECTS in any form, Cellulose Acetate, Butyrate, Polystyrene, Acrylic, Vinyl Resin, etc. Also wanted surplus lots of phenolic and urea molding materials. Reply Box 318, Modern Plastics.

20 OZ. H-P-M INJECTION MOLDING MACHINE FOR SALE—Model #54, in excellent condition. Address Box 433, Modern Plastics.

FOR IMMEDIATE SALE: Semi-Automatic Hydraulic Presses, 2—125 Ton, 13" Ram, 23" x 17" platens, 2000 lbs. per sq. in. 1—400 Ton Horiz. Hydraulic Extrusion Press. 1—Hydraulic Scrap Baler, 80 Ton, 6 1/2" Ram, 90" stroke, 5000 lbs. per sq. in. Large stocks Hydraulic Presses, Pumps & Accumulators, Preform Machines, Rotary Cutters, Mixers, Grinders, Pulverizers, Tumbling Barrels, Drill Presses, Lathes, Gas Boilers, etc. Send for Bulletins #156 and #138, and L-17. We also buy your surplus machinery for cash. Reply Box 439, Modern Plastics.

FOR SALE: 2—84" Mixing Rolls; 10—Semi-Auto Presses, 75 to 400 tons, ejectors and pull backs; 4—Grould Triplex Hydraulic Pumps, 2—1500 PSI, 35 GPM, 2—3000 PSI, 18 GPM; 12—30" x 40" PLATEN, 500 ton Hydraulic Press, 1—W.S. 15" x 18" Hyd. Press, 9" dia. ram, 4" posts; 1—W.S. 24" x 48" Hyd. Press, 12" dia. ram, with hyd. pushbacks; 1—46" x 54" Hyd. Press, 19" dia. ram; 1—Thropp 36" x 36" 4-opening Hyd. Press, 12" dia. ram; 2—Bethlehem 38" x 78" Hyd. Presses, with 20" dia. rams; 1—Farrell two-cylinder vertical Hyd. Extrusion Press and Pump; Birm. 16 x 36 Mixing Rolls, silent chain 40 HP drive; 1—Farrell 14" x 30" Rubber Mill; 1—Allen 16" x 42" Rubber Mill; 7—W. & P. Mixers. 1—50 gal. Nickel Vac. Pan. Send for Complete List. Reply Box 446, Modern Plastics.

MANUFACTURERS REPRESENTATIVE. Aggressive sales engineer wants Plastics Line for Chicago Territory: Vast experience in molded and laminates. Proven design and development ability available to manufacturer. Reply Box 448, Modern Plastics.

WANTED: Used Buffing Wheels. Will buy & pay cash for any quantity of used buffs from 6" up. Submit sample. Manufacturer's Salvage Co., 507 Eddy St., Providence, R. I.

FOR SALE: SEMI-AUTOMATIC HYDRAULIC PRESSES Two—Burroughs, 12" Ram, Semi-Automatic Hydraulic Presses. 170 tons capacity at 3000 lbs. working pressure. Equipped with pull-backs and hydraulic knockout in lower platen. Denny & Clark, 910 No. Marshfield Ave., Chicago, Ill.

WANTED: 1 oz. or more capacity injection molding machine must be good condition and cheap for cash. Our production limited on small novelties, hence tremendous quantity production not necessary but must do nice work. Make or age of equipment not important if price is right. Ernest V. Meade, Mfr., Box 100, Portland, Michigan.

WANTED—2 and 1/2" or larger modern screw-type plastics extrusion machine. Will pay cash for new or used unit. Reply Box 449, Modern Plastics.

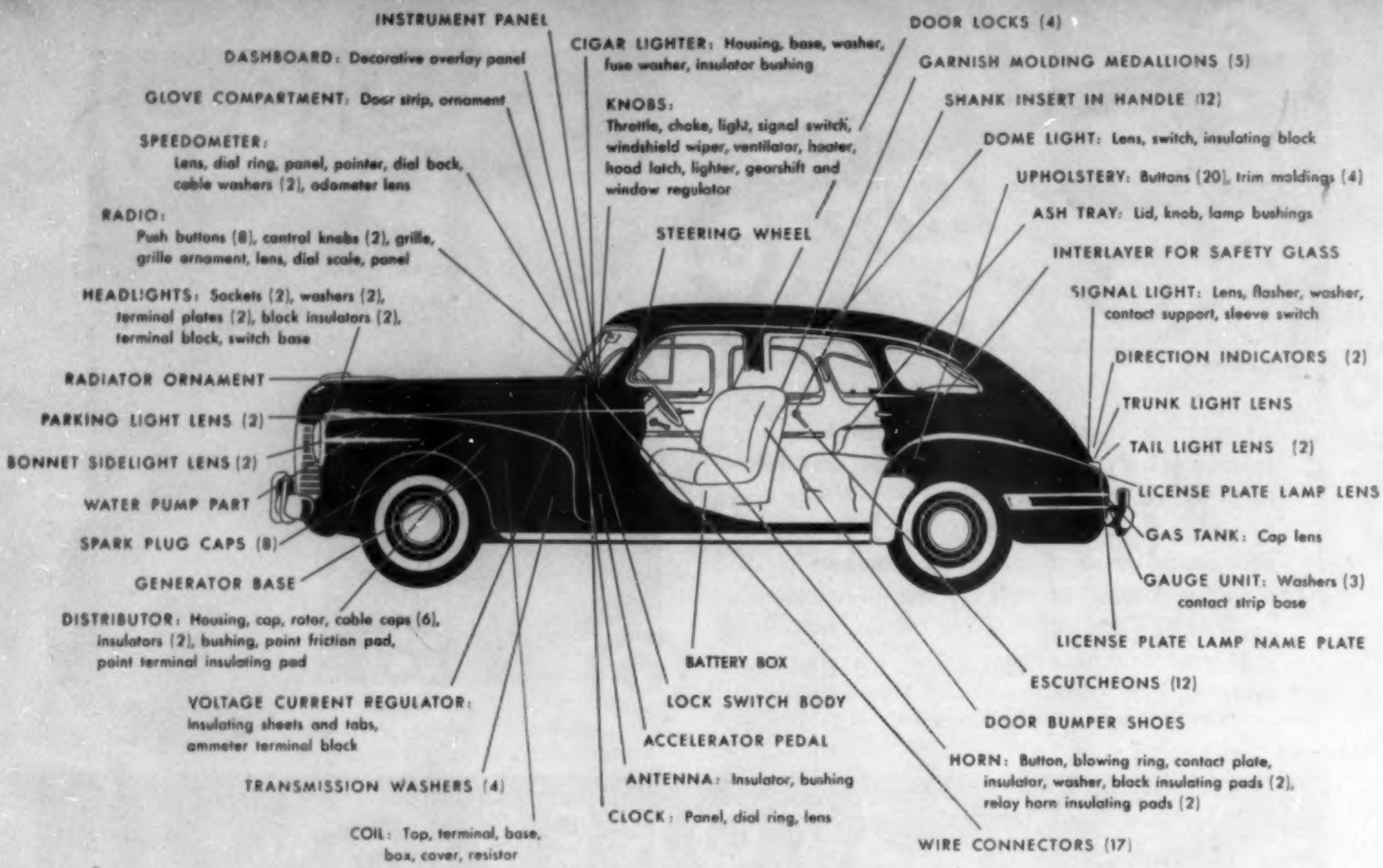
$10,000.00 to invest in established plastics molding, extruding, laminating or fabricating business. Young, energetic, successful executive wishes to invest his money and himself in a firm capable of absorbing both in expanding production. Active, *productive* participation necessary. Reply Box 450, Modern Plastics.

New York City plastic manufacturer has vacancy for experienced man with practical technique on operation of injection and extruding machines. One with sound mechanical background preferred. Applicant must possess good constructive ideas regarding gigs and auxiliary fixtures. State in detail, salary and experience. Reply Box 451, Modern Plastics.

WANTED—Product of merit, and appeal to the Syndicate, Chain Drug, Premium, Department store, and Jobbing trades. Advertiser's personal sales to above for the last 15 years were never less than $300,000.00 yearly. The service includes a Fifth Avenue Show-room, merchandising counsel, and Styling on a strictly commission basis. Only reliable manufacturer of strong-volume product need reply. Bank, and trade references exchanged. Reply Box 452, Modern Plastics.

Injection tool, mold maker, executive ability, well grounded in the Design of molds, tool, dies and fixtures. Also in the molding technique and molding powders for the Plastic trade. Desires to contact a firm or organization which is sincerely interested in aggressive action and requires the services of a first class above the adverage individual. Willing to locate anywhere. Reply Box 453, Modern Plastics.

ACTIVE PARTNERSHIP SOUGHT by capable executive, 39, College background, general business experience, with funds to invest in established plastics concern. Location of secondary interest. Reply Box 454, Modern Plastics.



Present and potential uses of plastics in the modern automobile

★ INCREASED USE OF PLASTICS BY THE AUTOMOBILE industry will be reflected in 1942 motor cars in which more than 120 parts will be made of these relatively new materials. This figure is the result of a survey of the larger motor car manufacturing plants by the Du Pont Co. Plastics Department.

There are some 110 plastic parts on the composite 1941 automobile, the survey revealed, with a total of more than 225 possible applications of these parts. They range from upholstery buttons to steering wheel, from accelerator pedal to laminated safety glass interlayer.

Plastics will be incorporated in larger quantities on impending 1942 models not only because of the scarcity of certain metals, but also because plastics have, in addition to great durability, the advantages of new color, new beauty, lighter weight and greater economy, say automotive engineers.

However, they warn against an exaggerated idea of the adaptability of plastics, and do not predict an early solution of the problem of molding large body sections from these materials.

Automobile manufacturers are spending large sums in research on molding and applications of plastics, realizing that they will play an increasingly important role in automobiles. Plastics manufacturers spend even larger sums in research on new and improved products, not only for the automotive, but also for other industries.

New plastics have been developed at about the rate of one a year for the last ten years. Each new plastic has been utilized on automobiles in one form or another. The graphic illustration (above) enables the reader to become familiar with the numerous plastic parts in today's automobiles.

★ CROWLEY AND BENNETT, A NEW FIRM OF TECHNICAL consultants, will open offices at 6803 N. Clark Street, Chicago, in the West and at 228 King Street, Brooklyn, in the East. Clyde A. Crowley is well known for his work in electrochemistry. Harry Bennett is well known as Editor of the Chemical Formulary, his work on emulsions, special formulae and other modern chemical developments.

DIRECTORY LISTINGS FOR 1942 MODERN PLASTICS CATALOG

If any of our readers have entered the plastics field in any way during the last year and wish to be listed in our new 1942 Directory we urge them to request a listing blank. This must be returned by July 31, 1941.

There is no cost or obligation involved through this listing and we hope you will cooperate to make this new Catalog-Directory as complete as possible.

Listings include: Molders, Laminators, Fabricators, Applied Decoration, Raw Materials, Supplies, Chemicals, Machinery, Molds, Equipment, Extrusion Processors, Designers and Consultant and Testing services, Educational institutions.

★ A NEW METHOD OF MARKING ENAMELED METALS and plastics without engraving is announced by the Acromark Corp., 251 North Broad St., Elizabeth, N. J. This method is said to reduce marking time and give attractive results. Successful results have been obtained with Roxalin metal coatings. The process consists of a steel die application to the coated metal under electrically controlled conditions and the mark of metal or color pigment results. Binocular parts, enameled tubes, camera parts and a wide variety of enameled metal products can be trade-marked, numbered, or otherwise marked by this new process. For phenolic, or other plastics, a similar method is used, but both dies and the pigment, or metallic coating, have to be made especially to suit.

Sorry!

★ IN REPORTING IN THE JUNE ISSUE THE NEW appointment of James D. Milne, we didn't mention that his new position is Division Manager of the Fort Wayne plant of the General Electric Plastics Department. (*Please turn to page 100*)

Table IV. Swelling of Typical Phenolics in Boiling Water

Type No.[a]	Type of Plastic	After 1 Day Length	After 1 Day Thickness	After 4 Days Length	After 4 Days Thickness	After 1 Week Length	After 1 Week Thickness	After 2 Weeks Length	After 2 Weeks Thickness	After 10 Weeks Length	After 10 Weeks Thickness	After 15 Months Length	After 15 Months Thickness
		% Swelling Upon Immersion in Boiling Water											
5	Laminated phenolic, fabric base, Grade L	0.25	2.6	0.27	3.8	0.18	4.1	0.18	4.3	−0.12	5.6	−0.23	5.2
10	Molded phenolic. Special for low water absorption	0.21	0.2	0.41	0.5	0.53	0.7	0.60	0.7	0.73	0.7	0.87	0.6
11	Molded phenolic. High heat and arc resistance	0.43	1.0	1.03	1.9	1.73	3.3	2.22	4.4	2.62	5.2	2.37	5.2
15	Molded phenolic. Mica filled	0.10	0.2	0.30	0.7	0.44	0.8	0.46	1.1	0.53	1.5	0.59	1.8

[a] A type number is assigned each commercial product tested for convenience in comparing results in all of the tables. Products bearing the same type number were all supplied by the same manufacturer under the same trade designation.

Dimensional changes of plastics

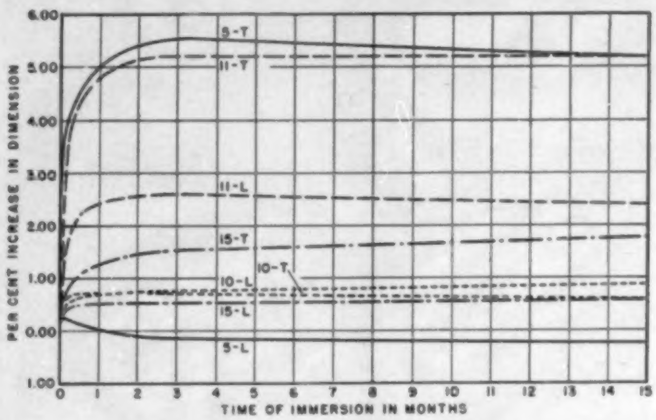
(*Continued from page 68*)

Weight increase of plastics upon immersion

Although the primary purpose of this investigation was to determine the dimensional stability of plastics in boiling water, the increase in weight after four days and after two years in boiling water, and after two years only in cold water, was measured, as well as the loss in weight of the samples during their preparation by drying at 105 deg. C. for one hour. The findings are presented in Table III. The increase in weight is not strictly proportional to the longitudinal swelling of the specimens examined, but is an approximate indication of its extent.

Change in thickness of plastics in boiling water

It might be supposed that if a 1 by $2^3/_4$ by $^1/_8$ in. sample of plastic swells in the $2^3/_4$ in. direction only a few thousandths of an inch, or less, then its simultaneous increase in thickness would be insignificant. This assumption is incorrect. The percentage swelling in a direction parallel to that of molding may or may not be much greater than in a direction perpendicular thereto, depending upon the nature of the material and the molding conditions. This observation is particularly true in the case of laminated phenolics. Thus, after fifteen months of immersion in boiling water, L grade laminated phenolic had decreased 0.25 percent in length, while it had increased 5.6 percent in thickness. On the other hand, samples of special low water absorption molded phenolic showed approximately the same percentage increase in thickness as in length after ten weeks in boiling water. Table IV contains values for swelling in both directions of certain types of material. Thickness measurements were made with micrometer calipers reading to 0.001 inch, ten-thousandths of an inch being estimated. Fig. 2 gives a graphical interpretation of these data.



2—Comparison of changes in length and thickness of typical phenolics in boiling water. (Curves are numbered according to Type Numbers of Table IV. Length swelling is indicated by L; thickness swelling by T.)

Return to dry state after protracted immersion

Several of the samples reported in Table I were removed from boiling water after two years of immersion, dried overnight in a desiccator above soda-lime, then overnight in an oven at 100 deg. C. and weighed. Drying at 100 deg. C. was continued for twelve days, weighing each day, until constant values were attained. Table V shows the percentage change in length and weight of these samples, based upon original dry values, before and after oven-drying following their immersion in boiling water for two years.

Conclusion

Data are presented which show the dimensional changes of a variety of plastics upon immersion in boiling water. Comparisons are drawn between the swelling of plastics in hot and cold water. Certain general relationships are indicated between the nature of the various types of plastics tested and their swelling characteristics.

The author wishes to express his appreciation of the courtesy of the Pittsburgh Equitable Meter Co. in permitting publication of the information contained in this paper.

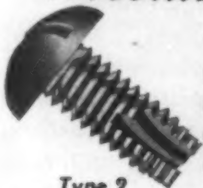
Table V. Behavior of Certain Plastics Upon Returning to Dry State After 2 Years in Boiling Water

Type No.[a]	Type of Plastic	% Change After 2 Years in Boiling Water[b] Length	% Change After 2 Years in Boiling Water[b] Weight	% Change After 2 Years in Boiling Water and Subsequent Drying[b] Length	% Change After 2 Years in Boiling Water and Subsequent Drying[b] Weight
5	Laminated phenolic. Fabric base. Grade L	−0.28	+ 3.43	−0.97[c]	−5.51[c]
6	Laminated phenolic. Paper base. Grade XX	+0.42	+ 4.22	−1.33	−7.53
11	Molded phenolic. High heat and arc resistance	+2.05	+ 5.68	−0.01	−3.12[d]
15	Molded phenolic. Mica filled	+0.46	+ 1.71	−0.20	−2.63
16	Molded phenolic. 100% resin; no filler	+0.82	+ 3.62	−0.63	−3.38
24	Cashew nut shell oil—formaldehyde cast resin	+0.14	+ 1.04	−2.27	−8.78[d]
28	Hard rubber	+8.21	+26.9	+1.51	−1.59

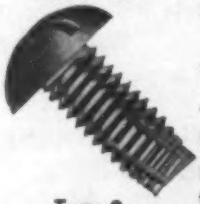
[a] A type number is assigned each commercial product tested for convenience in comparing results in all of the tables. Products bearing the same type number were all supplied by the same manufacturer under the same trade designation.
[b] Based on original dry measurements.
[c] Values after first day of drying. Both weight and length increased progressively upon subsequent drying.
[d] Slight increase occurred after fourth day of drying before constant weight was reached.

SHAKEPROOF

Thread-Cutting Screws



Type 2
Double-Slot



Type 9
Multi-Flute

● Because they actually cut their own threads in any plastic material, either molded or laminated, these two screws can save you time and money. The extra cost of threaded inserts or separate tapping is eliminated and tighter, stronger fastenings are assured.

WRITE FOR SAMPLES!

Try these screws on your own product—see for yourself how they can help you save time and protect product performance. Stock samples of the type desired for testing purposes will be gladly forwarded on request.

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DDS-2 Rotary with variable-speed drive, for standard shapes or balls up to 1 3/16" dia., at 250 to 350 per min.

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Stokes Presses are simple, practical machines, built for hard, continuous service and fully protected against overloads, jamming and damage. Frames are of Mechanite, combining the rigidity of castings with the strength of steel plate. Gears are well guarded. Bearings are large, bronze bushed. Simple adjustments to control pressure, density, weight and thickness may be made while machines are running.

Variable speed drives assure maximum production on preforms of various size and with different type materials. Core-rod type punches and dies may be used . . . to make perforated preforms.

Fourteen stock models, for large preforms, large output and general-purpose preforming, Single Punch and Rotary types. To apply pressures up to 80 tons. Also special models up to 300-tons capacity.

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Pacific Coast Representative: L. H. Butcher Company, Inc.

F.J.Stokes FJS Est. 1895

Continuous extrusion advances

(*Continued from page 37*) materials in a like manner. Either simple infrared conditioning, heating cabinets or drying ovens with a circulating air system are customary practice for such purposes.

Construction of dies

The dies which are used in extrusion are less complicated than injection molding types since they contain fewer cavities and the question of register is eliminated. Nevertheless, they constitute a major problem. There are no standard shapes. Where extruded plastics are being processed to take the place of metal shapes, they are, to some extent, following established patterns. As the art develops, regular forms will be standardized.

The construction of tools for running of sections which have variations of H and U shapes presents a complex problem. In addition to building the die correctly to compensate for shrinkage, the added problem of delivering these shapes with proper dimensions from the orifice is presented. Very often the solution of this problem is as important as the construction of the die. If these shapes and similar types aren't properly delivered from the machine they will collapse or otherwise deform, thus spoiling them for commercial application. Generally, extrusion dies have a restricted number of cavities. The number depends upon the cross section of the piece to be processed. Back pressure is essential to successful extrusion. The actual construction of the tools follows conventional methods. In some instances it has been found advantageous to chrome-plate certain extrusion dies.

In operating extruding presses it is necessary to use various temperatures for different sections. The type of material run also has a bearing on these conditions. During a production run of an even single item it may be necessary to change die temperature.

Almost every extruded shape presents new problems from the dimensional standpoint. Many factors, aside from the material itself, are considered in the effort to control dimensions during and following the actual extrusion. Regulated air and water temperatures are important. Then, too, jig fixtures and other attachments play a significant part in handling of certain complicated shapes. The success of the process revolves around careful, skilled operation and supervision.

7—Demonstration bar showing extruded ornamental trim

Dies for extruded parts are made from blueprints or samples supplied by the customer. The fine precision and detail in making compression and injection molds are not necessary in dies for extrusions. As a matter of fact, extruding dies are usually made somewhat larger than the finished piece, allowing for stretching to size on the conveyor belt. This stretching also tends to improve the surface finish. As compared with other molds, extrusion dies are small and inexpensive and yet the rate of production is exceptionally high—a strip 1 in. wide and 1/8 in. thick can be produced at approximately 750 ft. per hour.

Extruded plastics are strong, tough and more flexible than metal. They also have a smooth surface with high polish and excellent wearing qualities. Unlike molded plastic parts, extrusions need no subsequent finishing such as the removal of burrs, buffing, etc. They are ready for use when they leave the conveyor.

Applications

The appearance of continuously extruded forms during the past year has received special attention in fields where molded plastics have not heretofore been considered. Woven strips and rods replacing reed and rattan in terrace furniture are in the limelight because of excellent weathering qualities and bright color.

Installations of tileboard and wallboard can be greatly enhanced by the use of extruded plastics. Kitchens, bathrooms, playrooms can be made even more attractive with this colorful material.

In the commercial fields, the decoration of restaurant walls, cafés, hotel lobbies, powder rooms and a host of other decorative trim applications give both designer and architect new materials for unique creations.

Several companies have developed lines of extruded moldings which are particularly adapted to building and allied industries. These are in shapes that duplicate metal strips used for the same purpose. The plastic is placed along the seams in the wallboard and then forced into the cracks. Once inserted, the molding is held firmly in position by a flanged portion of the strip that prevents the plastic from loosening, just as the arrow form of a fish hook prevents the hook from being readily withdrawn.

Typical examples of the use of these extruded lengths are pictured in these pages. The table shown (Fig. 3) is trimmed with a "T" shape plastic molding which is assembled to the table by inserting the projecting leg into groove of table. The bar (Fig. 7) is a complete plastic product using a specially designed edging of one color which is nailed in place and an insert of a contrasting color which not only serves the purpose of decoration but conceals the nails as well. The panels are held in place by colorful border strips in contrasting colors and finished off with capping strips. The ends are trimmed with outside corner strips.

The present metal crisis in the industrial field can be relieved to a large extent by plastics. Such industries as washing machines, refrigerators, toys, furniture, radio, etc., require a finishing trim; all use some type

of architectural shape which can be made from plastics by the extrusion method. The automotive field, with interior trims, has been up to the present time the largest user of extruded plastics. Another large consumer of plastics is the insulated wire field. Many new opportunities will develop through natural evolution, but there are many which will require careful engineering analysis and development. Plastics have certain limitations which must be considered before adaptation. The sale of extruded plastics in a field where their use is not practical will react unfavorably throughout the entire industry.

Raw material manufacturers have facilities for testing to determine practicability for any unusual application and are only too glad to cooperate with prospective users in this respect. With the continuous extrusion machines now available, the usual type of molding composition in granular form can be used, making possible the rapid production by custom and private molders of many types of special shapes and sizes in any desired length. This opens a new field which will become of increasing importance in the very near future.

Credits: Material—Lumarith, Tenite. Extruder—R. D. Werner Co., Inc. Equipment—National Rubber Machine Company.

To escape wartime jitters, here's a bowling pin game with base of the ten pin (also used as a die cup) and ten cubes molded of urea. Smart adult games use plastics for color and quality

Playing up a market

(*Continued from page 49*)

On a tiny freight car of HO gage in $3^1/_2$ mm. to a ft. scale, Varney Railway Models use injection molded cellulose acetate sides, with door, slats and realistic details. (Fig. 13.) Each side is molded in one piece, eliminating the necessity for carving or machining the slats and reinforcing the ribs.

Perhaps the most spectacular advance in plastics was made in the field of musical toys. During the past few years molded whistling toys, saxaphone mouthpieces, an all-plastic harmonica, ocarinas and recorders have joined the ranks. The outstanding successes, however, have been made by the Chicago Musical Instrument Co. who have developed inexpensive, eye-appealing musical toys which help youngsters to start their musical education. Let the sales record speak for itself! R. V. Mathews, advertising manager of the company, writes as follows:

"Within 90 days after the little 25-cent Bugle boy, a small bugle in patriotic red, white and blue, which plays all the calls (Fig. 7), was put on the toy counters of America, over a million were sold. This was due largely to the fact that—in plastic—it was possible to produce an instrument musically correct, yet attractive and low priced. The Cadet Bugler, 'Big brother,' of the Bugle boy, sells for $1.00. It is a consistent year-round seller in all types of outlets because, here again, we were able to produce an instrument to sell at low cost, yet good looking enough and pitched correctly to blend in with real brass bugles.

"The Tonette, first musical instrument we put out in plastics, has a nice flute-like tone, true intonation and an octave and a third range. It has made it possible for children to be initiated into the fun of music no matter what the limitations of their parents' pocketbooks. It leads children directly into the study of all other musical instruments because with these they can learn the fundamentals of music easily and quickly. About 60 percent of the grammar schools in the country have adopted Tonette as standard pre-band equipment. Leading radio and motion picture entertainers use it for novelty effects and the U. S. Navy band has equipped its entire woodwind section with them!

Adult games continue to depend largely on plastics for quality merchandise. With the revival of Mah Jong, handsome cast resin playing pieces, tile racks and money pieces top the field, with manufacturers striving for unique color effects and designs in a wide price range. Poker chips are popular and durable in plastics. As for chess, hand carved chessmen of transparent acrylic and cast resin, as well as precise injection molded cellulose acetate pieces, bring new life to this time-honored pastime.

While plastics can do much to improve appearance, color-appeal and durability of toys, they will not always prove the answer to competition based on cost without consideration of other factors. Likewise they are not always the right choice for existing designs. Plastic materials differ basically from other materials generally used in toy manufacturing and it is vital that a full appreciation of their characteristics be obtained before translating them into sales-winning articles. For example, plastics have not yet been found feasible for the

important wheel goods category using sheet steel—or for aluminum tubing and sheets for model airplanes. But the ingenuity of American manufacturers, plus a willingness to understand plastics from all angles and design accordingly, should do much to overhaul existing merchandising policy.

Evidence of this trend is seen in the fact that less than 5 percent of toys have been imported from abroad in the last ten years and less than 2 percent in the last two. With toy imports scraping bottom, the toy industry can plan a campaign to wean people away from a conviction that most toys are designed and made abroad.

Credits: Materials: Lumarith, Tenite, Lustron, Catalin, Bakelite, Beetle, Plaskon. Molders: Gits Molding Co., Kilgore Mfg. Co., Elmer E. Mills Co., Consolidated Molded Products, Elgo Plastics, Inc., H. Jamison, The Richardson Co., The Atlantic Plastics Co., The Woodruff Co., Arrow Plastic Co., Columbia Protektosite Co., Herkimer Tool and Model Works, Gillum and Co., Chicago Die Mold Mfg. Co., Manufacturers: Bergen Toy and Novelty Co., Chicago Musical Instrument Co., Sensible Toys, Inc., Holgate Bros. Co., Hoover Products, Inc., Varney, Inc., The A. C. Gilbert and Co., Lionel Corp., Comet Model Airplane and Supply Co., Hero Mfg. Co., Tykie Toy Co., Halsam Products, Inc., Raymond Labs, Inc., Spare Time Game Company.

Melamine and derivatives

(***Continued from page 40***) appearance to urea molding powder, molded in the same manner, and in the molded form, identical in appearance. However, the molded melamine-formaldehyde resin was considerably harder, more heat-resistant, showed greater resistance to dilute acids and alkalis, and had a lower water absorption factor. (See Table I.)

So far this material has been molded into tableware for the airlines, where continual contact with hot foods, boiling water, fruit juices, etc., provide severe service tests. So far the results have been very promising, and tests are continuing (Fig. 5).

It was also found that melamine resins were suitable for laminating purposes. As a resin for surface treatment, the material provides a hard, durable, colorless surface for wood veneers, or paper lamina. It is more heat-resistant than the ureas or thioureas, does not scratch or mar so easily, and is less affected by fruit juices, alkalis, acids and common solvents.

Perhaps one of the most outstanding applications for laminated plastics is the inner panel of the Westinghouse refrigerator door, surfaced with melamine-formaldehyde[3] resin. Notable qualities gained in this use are unsurpassed combinations of gloss and color retention, even when subjected to high temperatures for prolonged periods of time. The development of melamine resins, together with improved alkyd resin plasticizers now makes possible the formulation of baking enamels which will stand 400 deg. F. or even higher for prolonged periods of time without appreciable loss of gloss, and at the same time retaining good adhesion, resistance to impact and abrasion. This would

[3] "New Materials in Refrigerators," Modern Plastics, May 1939, page 30.

TABLE I—PROPERTIES OF MELAMINE RESINS

	"Melmac" Laminated	"Melmac" Alpha Filled
Specific Gravity	1.4–1.6	1.4–1.6
Molding Temperature, °C.	130–150	150–160
Molding Pressure, psi.	500–2000	1000–4000
Molding shrinkage, mils. per in.		6–9
Aging Shrinkage, mils. per in.		5–10
Water Resistance, gain in weight		
15 min. boil (3 in. × 1 in.)	0.5–1.5%	
24 hrs. cold (3 in. × 1 in.)	1.5–2.5%	
30 min. boil (tumbler)		0.7–1.5%
7 days cold (tumbler)		2–4%
Heat Resistance		
Temperature for visible discoloration, 1000 hrs.		210° F.
Stability to light (natural color)	Good	Good
Resistance to Abrasion	Excellent	Excellent
Mechanical Strength—Dynstat		
Static, 0.040 in. thick	1000–1400 kg. per sq. in.	
Impact, 0.040 in. thick	16–20 cm. kg. per sq. in.	
Static, 0.80 in. thick		900–1100 kg. per sq. in.
Impact, 0.80 in. thick		8–10 cm. kg. per sq. in.
Electrical Properties		
Dielectric Strength Short time, 0.80 in. thick		
Room Temperature, vpm.		300–350
100° C., vpm.		120–160
Arc Resistance, seconds	90–120	90–120
Chemical Resistance		
Strong Alkali (10% NaOH)	Fair	Fair
Weak Alkali (1% NaOH)	Good	Good
Strong Acid (10% H_2SO_4)	Fair	Fair
Weak Acid (1% H_2SO_4)	Good	Good
Fruit Acids	Excellent	Excellent

indicate markets for such items as stove parts, electrical appliances where heat resistance is essential (Fig. 6).

It is perhaps unwise to guess at the future applications of this material, since it is only in the introductory phase. However, a bit of wool gathering, at least, exercises the mind!

In the molded form, the superior heat resistance of alpha cellulose filled melamine resins would indicate a greater use of plastics for lighting purposes, particularly with incandescent light sources. This same heat resistance should open up such applications as toaster handles, chafing dish trim, and perhaps even electric iron handles.

The superior water resistance, alkali and acid resistance should provide such applications as food and cosmetic containers, closures, etc., where conditions are such that other amino compounds are on the borderline of suitability.

Perhaps the superior hardness, color stability and general inertness may carry colored thermosetting resins in the molded form outdoors. To date, outdoor applications of amino molding materials have been very limited by their inability to stand continued weathering. In the laminating, surface coating and baking enamel fields, outdoor applications (*Please turn to next page*)

(*Continued from page 92*) are quite feasible (Fig. 7). Translucent laminated will have better color retention and improved weathering qualities.

This *is* wool gathering in certain respects and should be so considered. The American Cyanamid Co. is proceeding slowly with the development of melamine resins, desiring in all instances to be certain of its products before releasing them. Applications of melamine formaldehyde resins are still in the trial stage and production has not yet passed from the experimental.

Sources of Information

1. "Melamine Preparation," by P. P. McClellan, American Cyanamid Co., Industrial and Engineering Chemistry, Sept. 1940.
2. "Putting the Heat on White Enamels," by John McE. Sanderson, American Cyanamid Co. Paint, Oil and Chemical Rev., June 1940.
3. "Synthetic Resins from Melamine," by John McE. Sanderson, American Cyanamid Co. Paint, Oil and Chemical Rev., April 1940.

Marvel of merchandising

(*Continued from page 55*)

used principally. The usual procedure is to cut out a more or less regular shape from sheet stock. Onto this base, text is applied either by silk screening or engraving, or by affixing jigsawed letters or other design elements. Add small plastic feet, or an easel, and the sign is complete. The sign is permanent and attractive; its cost moderate.

A simple, effective display piece is shown (Fig. 3) in connection with displaying rings. The background is merely a sheet of brilliantly colored phenolic resin material jig-sawed to shape. What can be simpler, yet more attention getting? A shaped, solid piece of plastic is cast in an arbor and cut to length as required. Polishing of the cut ends completes the manufacturing.

There is a growing tendency toward working with acrylics among designers because of the many uses to which it can be put. For example, rods can be drilled, tapered, pointed, cemented, notched, twisted, grooved and sanded for new and different design possibilities. Letters, symbols and numerals cut from sheets, or formed from rod stock is another excellent use for this versatile plastic. Such letters can be lighted from below or behind to produce a novel, luminous effect.

This material is of special interest to display men because of its ability to "pipe" or conduct light; carrying it through even a bent rod or sheet to emit it at an end, or edge, or wherever the surface is incised.

A manufacturer cannot predetermine or control the decorative scheme of the store into which his display must fit, but the perfectly neutral character of the clear material permits these types of displays to be used without clashing with their surroundings.

While these items have a major outlet in the scope of packaging and display, products fabricated out of sheets and rods of the acrylic resins, cast phenolic resins, cellulose nitrates, and casein plastics are more diversified in application and consequently there are more intricate and varied means of manufacture. But simple shapes are produced as well. Solid balls are most easily made of rod stock, cut into short lengths, and either ground or tumbled to roundness, or both. These balls find one of their widest uses in the jewelry industry. Millions upon millions of plastic balls of every diameter, particularly of phenolic and acrylic resins, of opaque, translucent, transparent and pearlescent materials are used annually for necklaces, earrings, rings, brooches, pins, clips, and other jewelry having bead-like units. Half-round beads, of the same materials, find their way likewise into rings and earrings; clips, and cuff buttons. Similarly, a plastic sphere, into which is machined a mechanical thread, may become the cap of a perfume bottle, a lampshade knob, or the colorful handle of a parasol or umbrella. These same shapes and forms are useful in the fashion trades.

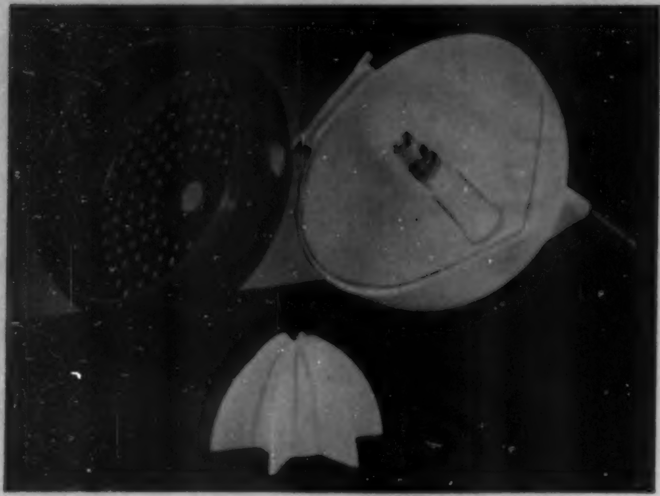
In other domestic surroundings decorated in the modern trend one will notice a dozen objects made of, or embodying, fabricated plastics. Whole pieces of furniture, such as chairs, beds, coffee, or end tables, may be made of bent and shaped or curved acrylic resin sheet and rod stock. Accessories such as waste paper baskets, magazine racks, fine lamps, vases, hanging shelves, book-ends, picture frames and desk sets are now being fabricated in fairly large quantities.

Inherent in the molding of plastics is the question of mold costs and quantities. Where a manufacturer produces an item that will sell in the tens or hundreds of thousands, his mold cost, amortized over the entire run, amounts to little per unit, and can easily be absorbed. When merchandise is sold in quantities of one, or ten, or a hundred, or even a few thousand, the cost of a mold cannot possibly be absorbed, so fabricating is the method employed.

It must be remembered that labor in fabricating will run higher than labor in molding. In molding, the labor consists of tending the molding machines, and a slight bit of grinding or polishing of the flash. In fabricating, a whole piece must be constructed, often entirely by hand, of the plastic stock. It may have to be lathed, or it may have to be jig-sawed; it may need bending, while heated to a pliable state, over wood forms. Grinding and polishing are other unavoidable operations. All these processes are done by hand and are complicated, requiring skilled and experienced labor. Costs run relatively high for this kind of work. Unnecessary cuts or complex bends should be eliminated if possible. Inside surfaces, hard-to-reach for polishing, must be minimized. Plain squares, ovals, rounds and oblongs are easily cut and combined and, if possible, should be used. Plain curves are always preferable to elaborate forms.

While plastic materials are considered to have an affinity for modern designing, it is equally true that modern designing, with its elimination of detail and with its straight and plain curved lines, is particularly adapted to fabricated plastics. Moreover, the knowledge of the availability of plastics and the way to handle them plays no small part in influencing design, so that production along these lines is steadily increasing.

Credits: Duranol, Lucite, Catalin, Plexiglas. Fabricated by Joseph Meyer Bros.—Ray Dumont Studios.



Three injection molded plastic parts provide a better looking lighter, and more efficient juice extractor

Super juice extractor

(*Continued from page 42*) The reamer was redesigned with a recess at the top to improve efficiency. It breaks fruit sacs close to the rind so that more juice can be extracted without adding the bitter portion of the fruit. The sunken top accommodates extra cores. As it pours the spout automatically strains pulp, seeds and cores from the juice.

A minimum of assembly attachments are used. There are about three tiny metal inserts which never come in contact with the juices, eliminating the dangers of tarnish or corrosion. Parts are all easily removed for cleaning. A stainless steel reamer insert which snaps over the shaft eliminates any threads or screws which might stick or wear. In use the unit is supported on the wall so that one hand is free to turn the handle, while the other holds fruit in position.

Lightweight, with a greater capacity than the all metal juicer, the new model is better looking, sturdier and more efficient. The fact that plastics replaced aluminum in this job was entirely due to its qualities and it was a happy coincidence when the company selected material that was not immediately affected by national defense program.

Credits: Bakelite polystyrene and Lucite molded by Injection Molding Co. for Dazey Churn & Mfg. Co. Designed by George Moeller, Chief Engineer, and Barnes & Reinecke

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Fiberglas and plastics

(*Continued from page 70*)
month flying and weathering tests of the Civil Aeronautics Authority. The glass fabric has the strength of cotton at one-half to two-thirds its weight; it is incombustible; it will not shrink or stretch with weather changes; it promises greater durability. But for wing, rudder, aileron or fuselage surfaces any fabric must have a dope or coating that leaves a smooth, weatherproof, abrasion-resistant surface. To date, no dope has been found that is as incombustible as the glass fabric, although some very promising slow-burning and fire-safe dopes are under test. The plastics industry is hard at work on this problem, too, and it is reasonable to expect that the problem will be solved before long. Every dope that shows possibilities is being tested for compatibility with Fiberglas and for weathering properties and durability such applications require.

Interior uses of Fiberglas products for thermal insulation, soundproofing and the lining of aircraft cabins are already extensive and these, too, usually require some use of a plastic for surface treatments or as a binding agent. The all-plastic plane, the molded plastic propeller, and thousands of different molded plastic parts of aircraft offer still unexplored possibilities for combining the high tensile strength of glass fibers with the toughness, compressive strength and durability of molded plastics. It might be noted here that the average tensile strength of glass fibers .00022 in. in diameter is calculated to be about 400,000 to 500,000 lb. per sq. in.—substantially above that of the strongest hard-drawn steel piano wire, at one-third the weight!

Fiberglas-plastic insulation is used for cold storage compartments

Experiments, of course, are under way in these fields. A few laboratory trials have been made of a compression member for aircraft use, in which glass filaments are combined with plastics to form hollow members that show a very high strength per unit of weight. The principle is that of bamboo, or reed, in which long fibers that have little compressive strength but high tensile strength are bonded together by nature's plastics to provide great compressive and tensile strengths with light weight.

The list is getting long, but is by no means complete. In a totally different direction we enter the field of flexible plastics—rubber-like materials—in which glass-fiber fabrics can play a major or minor role. Balloon cloths, parachute flare fabrics, so-called artificial leathers, awning fabrics, chemists' aprons, automobile top materials, tire cords, ropes and cordage and many other flexible materials can utilize plastics and resins in combination with Fiberglas.

Still unexplored, but of possible interest, is the use of glass fibers to reinforce transparent plastic sheet or

molded materials. Experimentally it has been found that when Fiberglas cloth, which in itself is translucent but not transparent, is embedded in transparent plastics that have the right index of refraction, the cloth seems to disappear, leaving a cloth-reinforced material of greater strength than the original plastic alone. The glass merely becomes transparent again by the alteration in the refractive index of the fiber surfaces.

There is no visible end to the partnership—or the brotherhood of interests—of modern plastics and glass. But nowhere does this partnership offer greater potentialities for mutual aid than in the combination of plastics with Fiberglas. Both materials are versatile in form, properties and uses. Each possesses properties the other lacks. Each has its work to do alone, but both can work together to perform new miracles for the advancement of American industry.

Miniature models plan a room

(***Continued from page 49***) if you use a kit of miniature furniture. It is not only a time and money saver, but it's fun to try those outlandish ideas that have been stored away in the back of your mind.

An interior designer who has recently devised a new Plan-A-Room scheme made up his initial symbols out of acrylic material. In this instance, too, the sets that are sold to consumers are made of wood. These plastic miniatures were featured in a Fifth Avenue window display along with a few exquisite jewels. The idea of using plastic material for the originals seems to be ideal from a promotional angle.

Credits: Plexiglas models designed by Eliel Saarinen in collaboration with Renzo Rutili, fabricated by Johnson Furniture Co. Plan-a-room models of Plexiglas by Paul MacAllister, Inc., Marcus window by W. B. Oakie, Jr.

London letter

It may seem rather strange to talk about toothbrushes when everyone is discussing military matters and conversation these days centers solely round aircraft, battleships and tanks. However, at the risk of appearing a trifle ridiculous the writer intends to devote a few lines to the nylon toothbrush. This is not, of course, new to American readers, but they will, nevertheless, be interested to know the reception given to this innovation by a nation at war.

The nylon toothbrush was introduced at a time when people might be expected to show not the slightest interest in anything but bombproof shelters and surgical equipment—yet from the moment of its first advertisement in the daily press the response was considerable and since then sales have steadily mounted.

Over two years ago a good deal of publicity was given to the pioneer work carried out by combined Optical Industries Ltd., on molded lenses, but this work was mainly experimental. Since these early days a great deal of research has been undertaken with the object of hardening the lens and making it scratchproof. On April 25, 1941, an announcement was made to the press that unbreakable scratchproof lenses of polystyrene are now being fitted into spectacles supplied to the troops. These new molded lenses are being made with the aid of 8000 different dies so that lenses can be supplied for almost every

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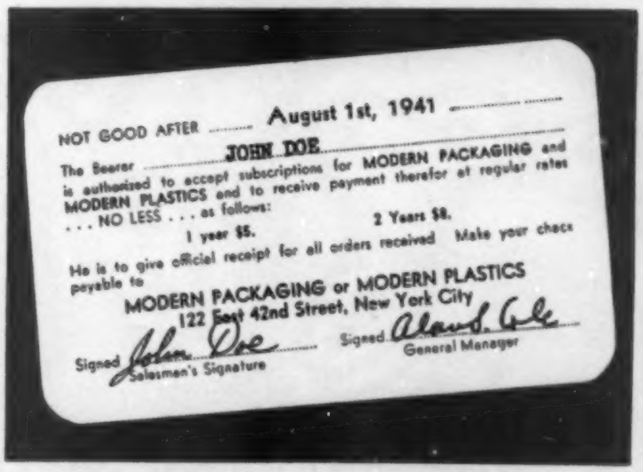

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Chanin Building, 122 E. 42nd St., New York, N. Y.

conceivable defect of vision. Each soldier is issued with two pairs of spectacles, one with flattened wings for wearing under his respirator and another for ordinary use.

As the older age groups are being called up for army service the degree of need for spectacles increases very considerably. In the 35–36 age groups between 13 and 20 percent require eye tests. Among the 19-year-olds the proportion was only 5 or 6 percent. There is no doubt that the introduction of these new plastic lenses to the armed forces will be a great boon because of the diminished risk of casualties from splinters. Splinters from ordinary ophthalmic lenses broken during action can cause very serious injuries and the use of the new molded lens will remove yet another hazard from the services.

Apart from the widespread use of styrene for ophthalmic lenses it is expected that there will be a considerable increase in the use of molded lenses for binoculars intended for use in the services. These have several important advantages over the normal types. First of all, they are unbreakable—a tremendous asset in modern warfare when dive bombers render it necessary to take immediate cover by throwing one's self down in a ditch or gutter. Then the plastic lenses are much lighter in weight than those previously made of glass so that the binoculars are easier to handle and more convenient to carry. The question of replacements is also of vital importance to the services. Glass lenses are extremely difficult to replace. Molded lenses, which can be produced at a fraction of the time taken for grinding glass ones, overcome this difficulty completely. The introduction of molded lenses also releases for more important service a large number of highly skilled workers, who were employed in such industries, and who are now urgently required for making high precision scientific instruments.

The urgent need for aluminum required by the Ministry of Aircraft Production is likely to present the British Plastics industry with new opportunities. All manner of familiar aluminum and non-ferrous metal luxuries and replaceable pieces of equipment in the services are being called in and, wherever possible, replaced by molded plastic articles. Both phenolic and urea molding powders are being generously used for these emergency applications. While there is no doubt that many of them are only "emergency" applications and will not remain any longer than the war, others are likely to be accepted as definite improvements.

Molded cups, beakers and mugs, etc., which fell out of favor except for occasional picnic sets, are now in great demand to replace chinaware for use in communal air raid shelters and also badly *blitzed* areas where stocks of china have been destroyed. Molders with old tools previously used to produce such ware are now taking them out of their storerooms and supplying this new market. People are no longer fussy about shapes and even the most unartistic molding will sell provided it fulfills its ordinary function. In these days of stark realism all that is needed is the bare necessity without any frills. *(Mailed May 5, 1941)* *Mrs. John Trevor.*

In the limelight

(*Continued from page 84*)

★ A GROUP OF 30 CLOSE BUSINESS ASSOCIATES OF Howard F. MacMillin, president and general manager of The Hydraulic Press Manufacturing Co., gave him a testimonial dinner recently at the Hotel Harding, Marion, Ohio. Paul Pocock, executive vice-president was toastmaster. Members of the committee for the dinner each gave a talk on the history and background of the company.

★ LAWRENCE E. BARRINGER, GENERAL ELECTRIC Engineer of insulations, was awarded the honorary degree of doctor of science at the June Commencement exercises of Alfred University's New York State College of Ceramics, Dr. Barringer has the degrees of E.M. in Ceramics and Cer.E. from his Alma Mater, Ohio State University.

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